TOTO20 E27E2760

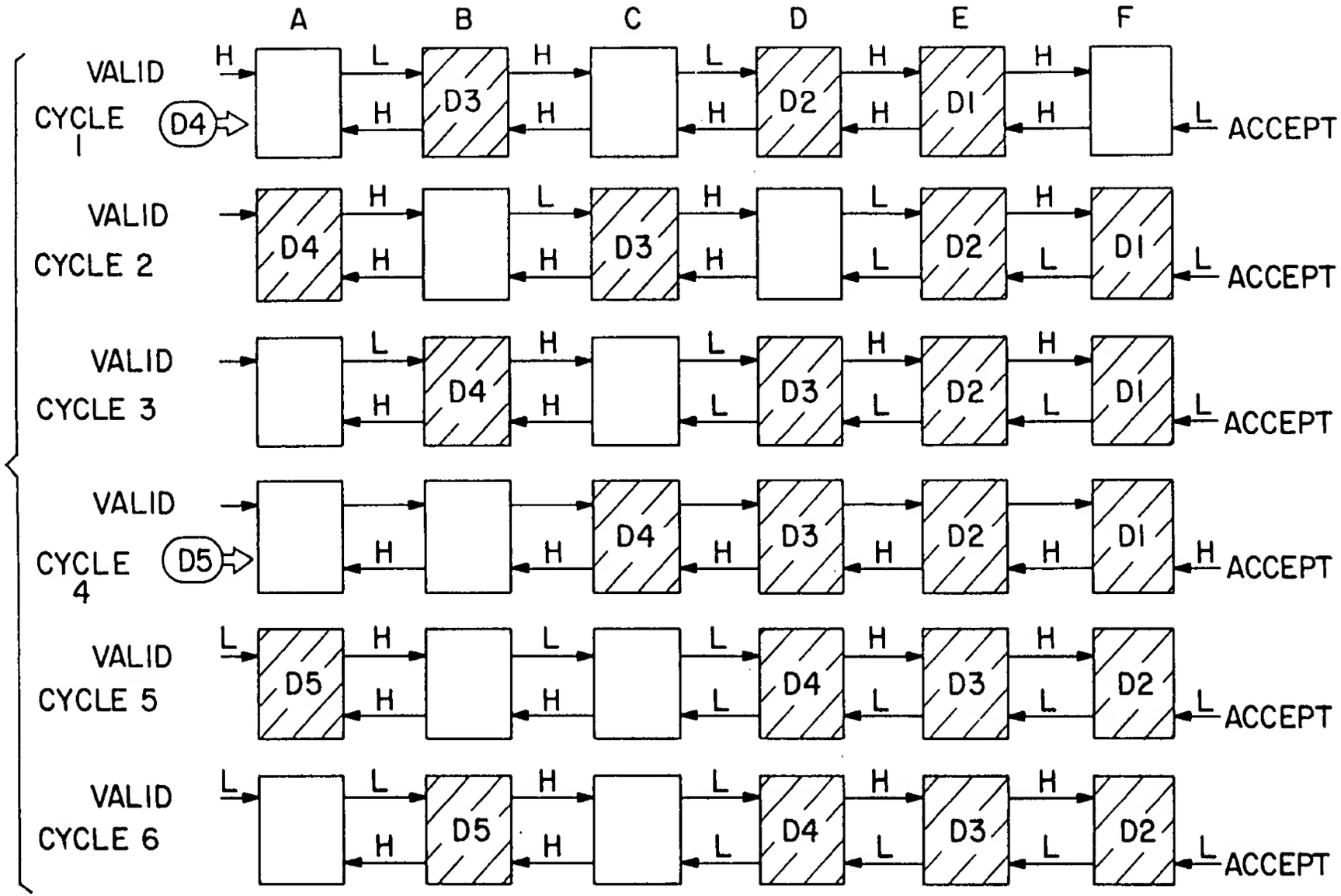


FIG. 1

JP1020 '62nE2260

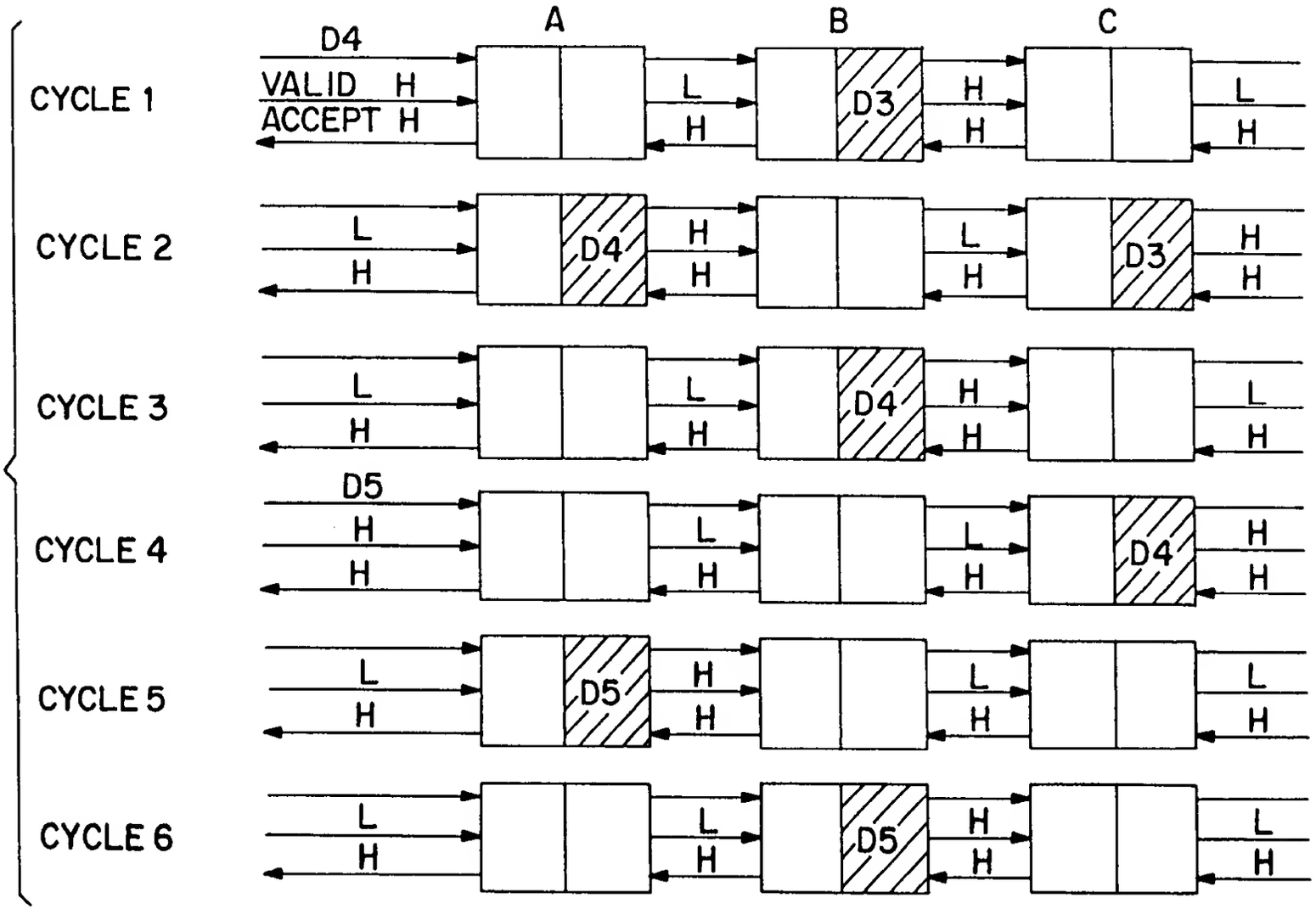


FIG. 2(A)

TOTO20 E2nE2260

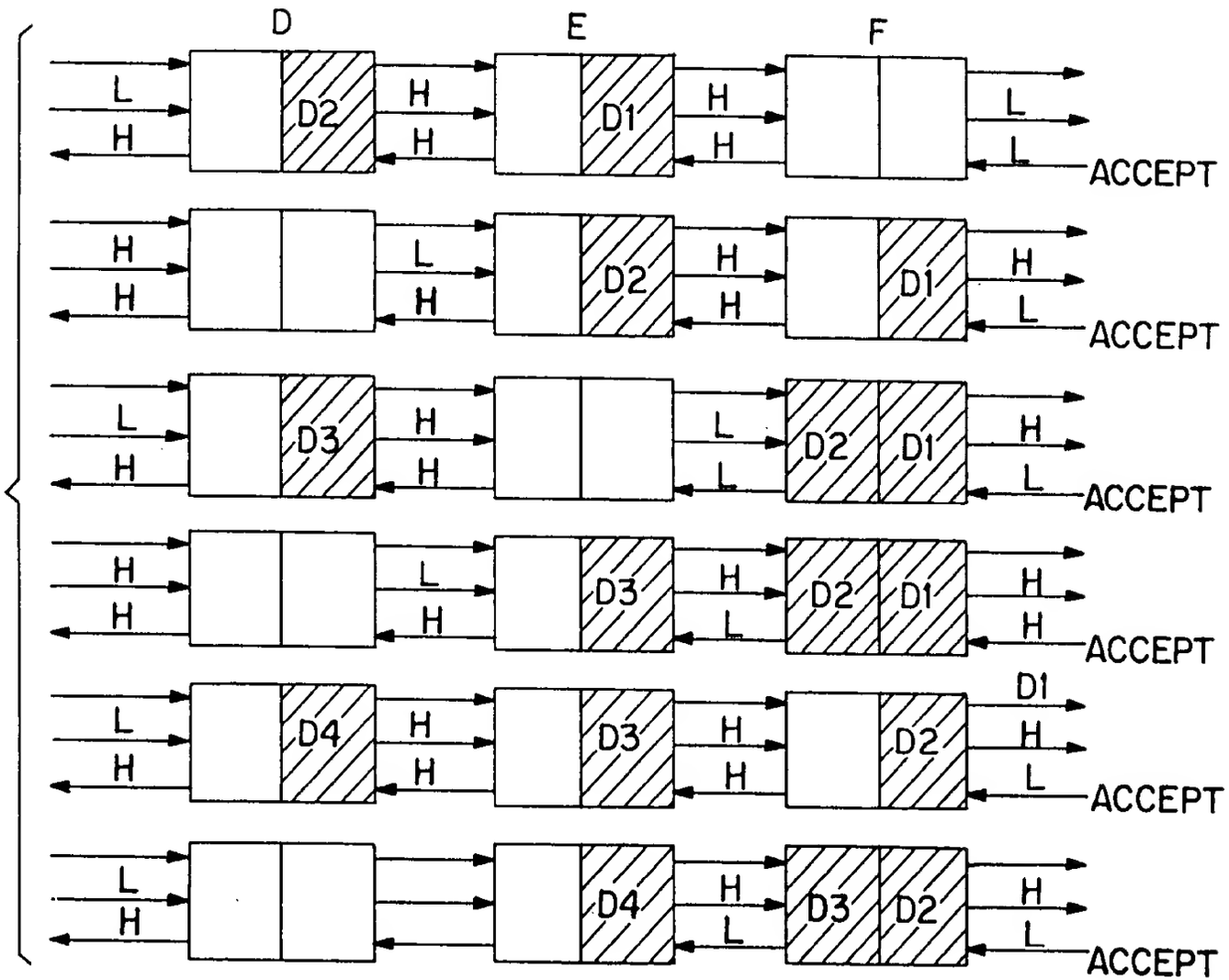


FIG. 2(B)

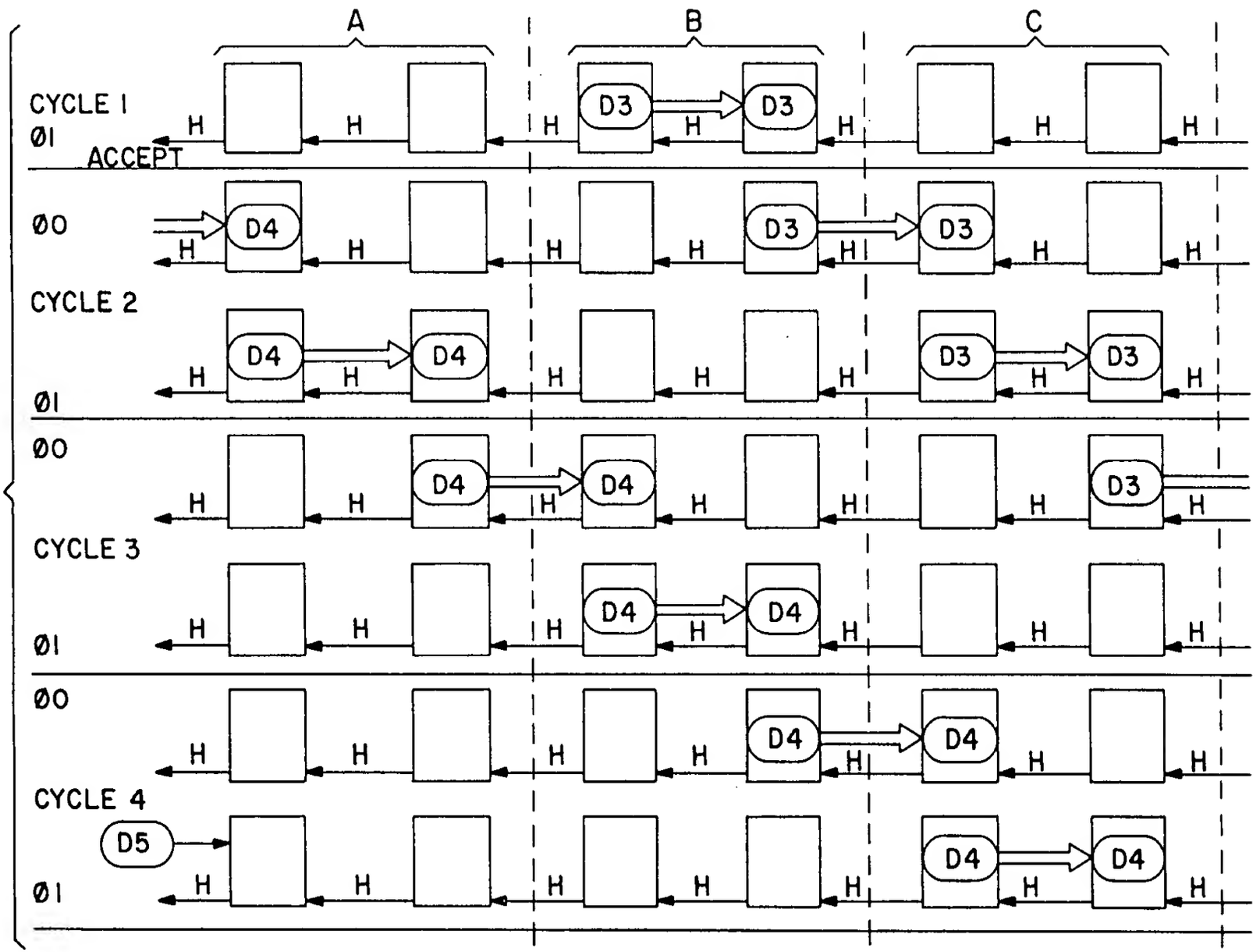

A
B
C
CYCLE 1
Ø1
ACCEPT
Ø0
CYCLE 2
Ø1
Ø0
CYCLE 3
Ø1
Ø0
CYCLE 4
Ø1
D5
D4
D3
H

FIG. 3A-1

TOTO20" E2nE2260

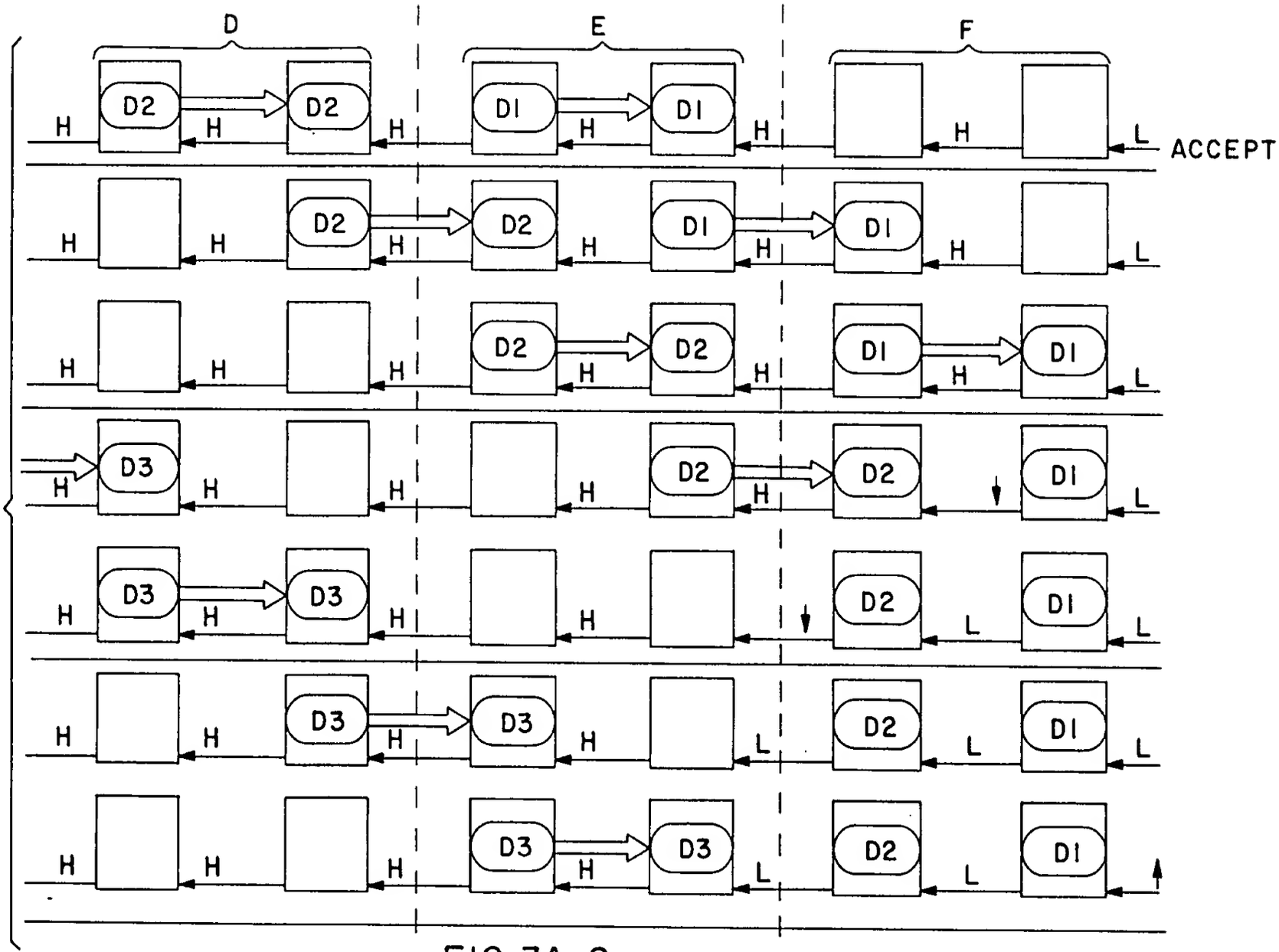


FIG. 3A-2

FOTO20" E2hE2260

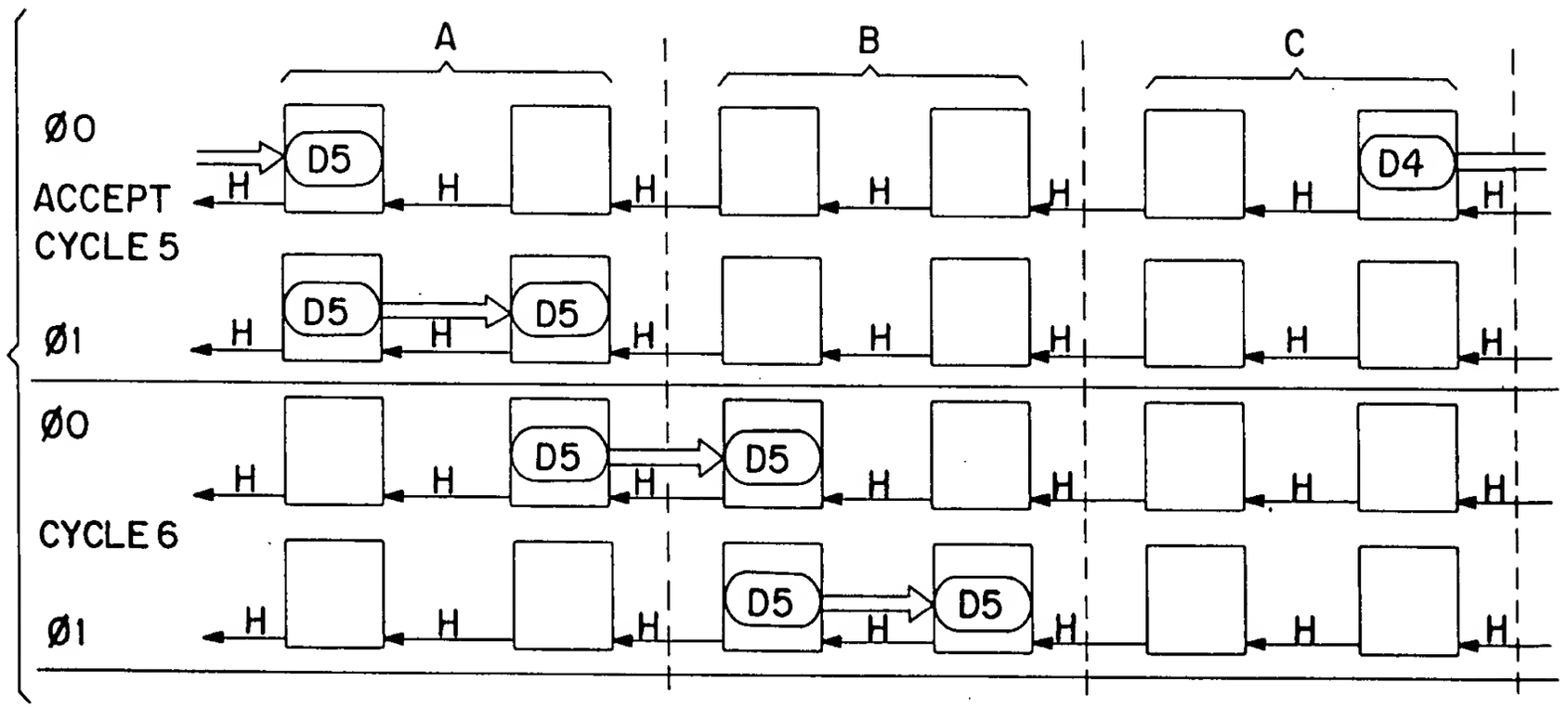


FIG. 3B-1

TOTO20" E24E2260

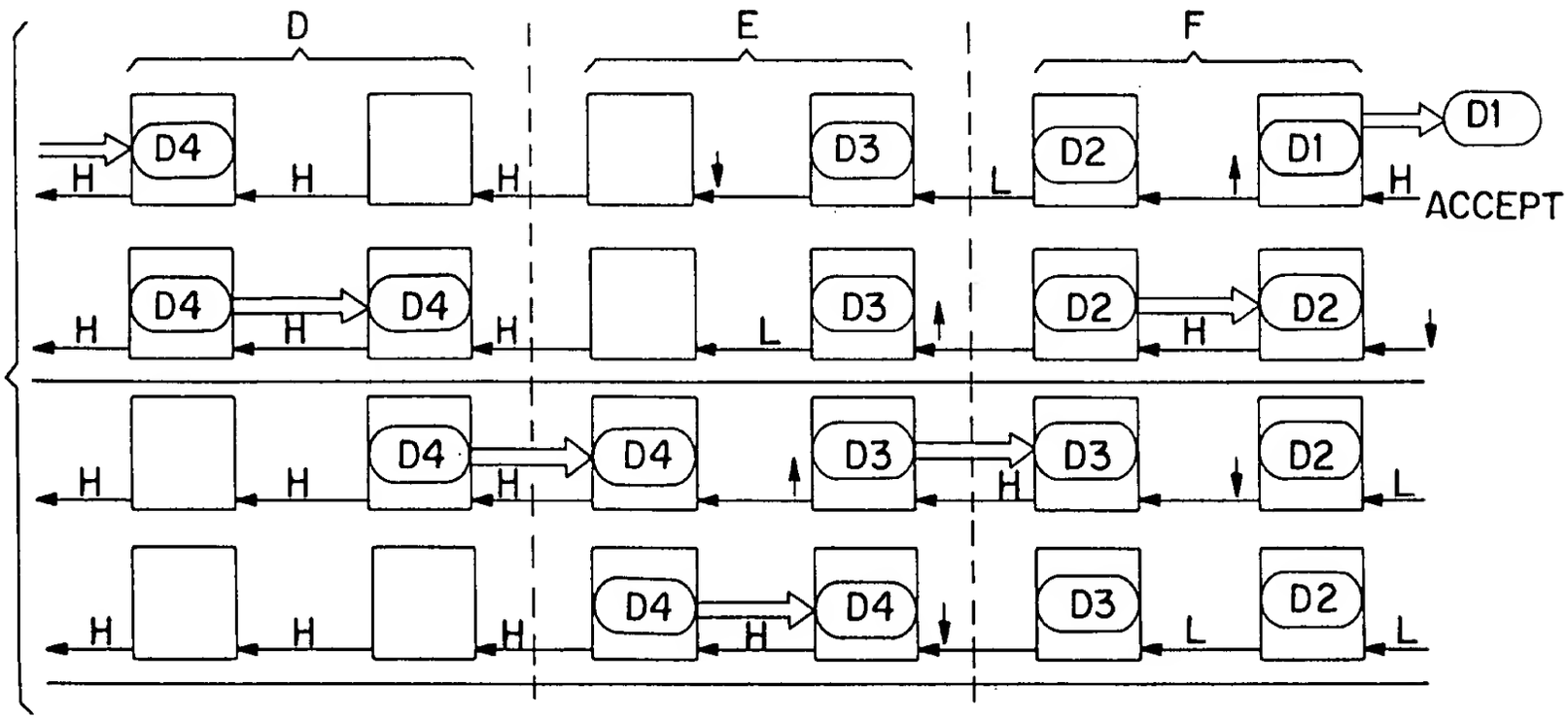


FIG. 3B-2

TOTO20 EZHEZ60

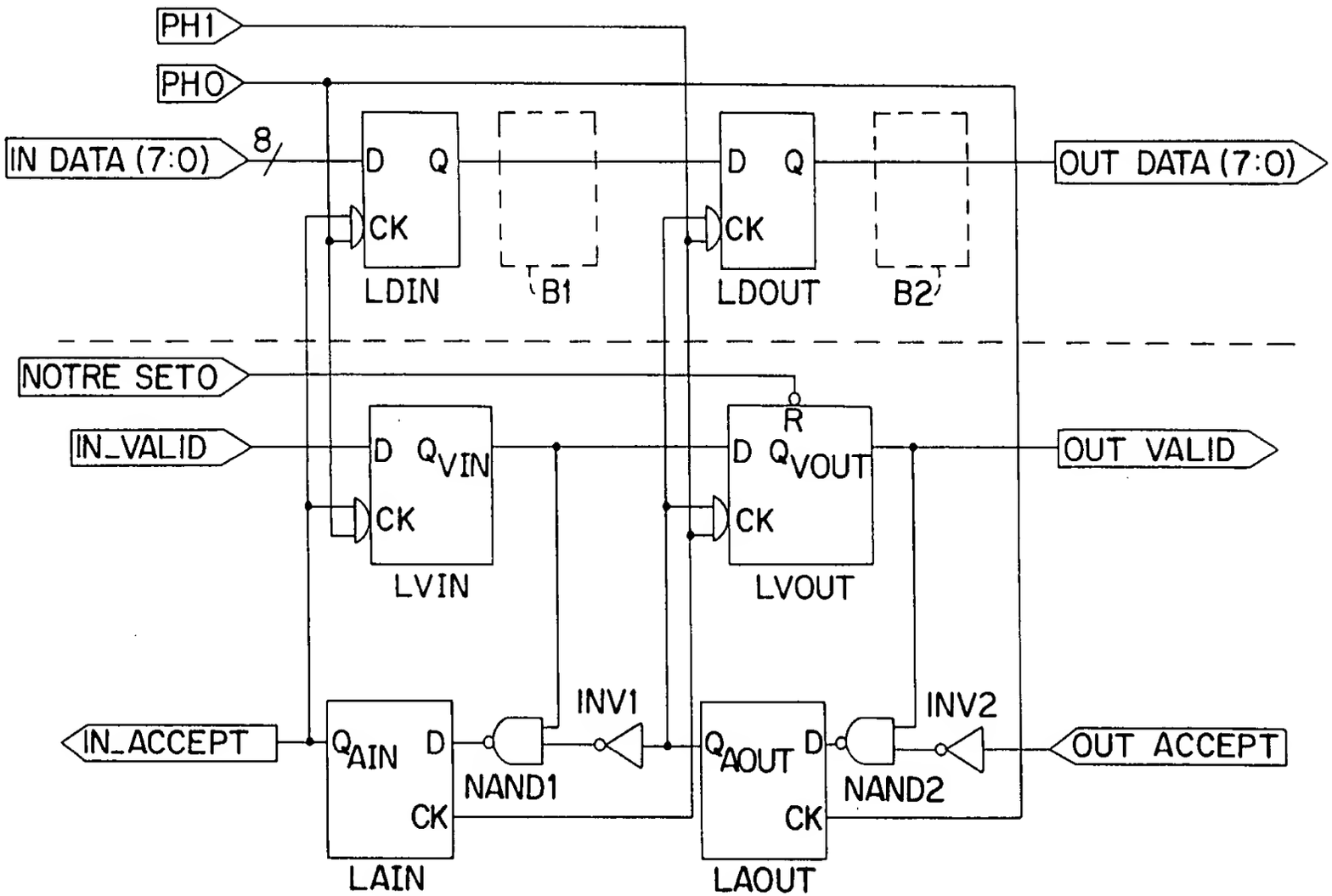


FIG. 4

TOTO20 EP4E2260

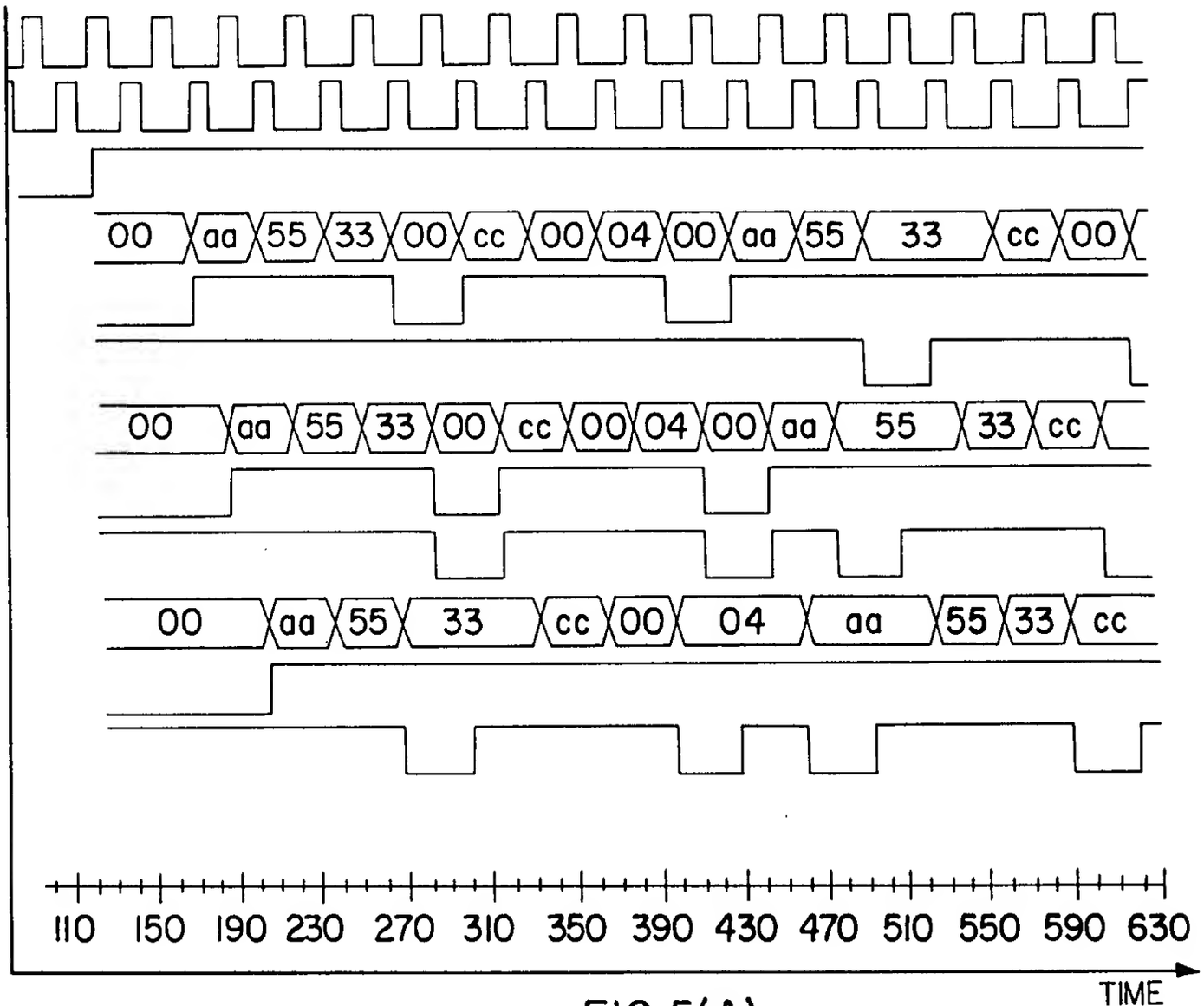


FIG. 5(A)

EP 0 720 320 A2

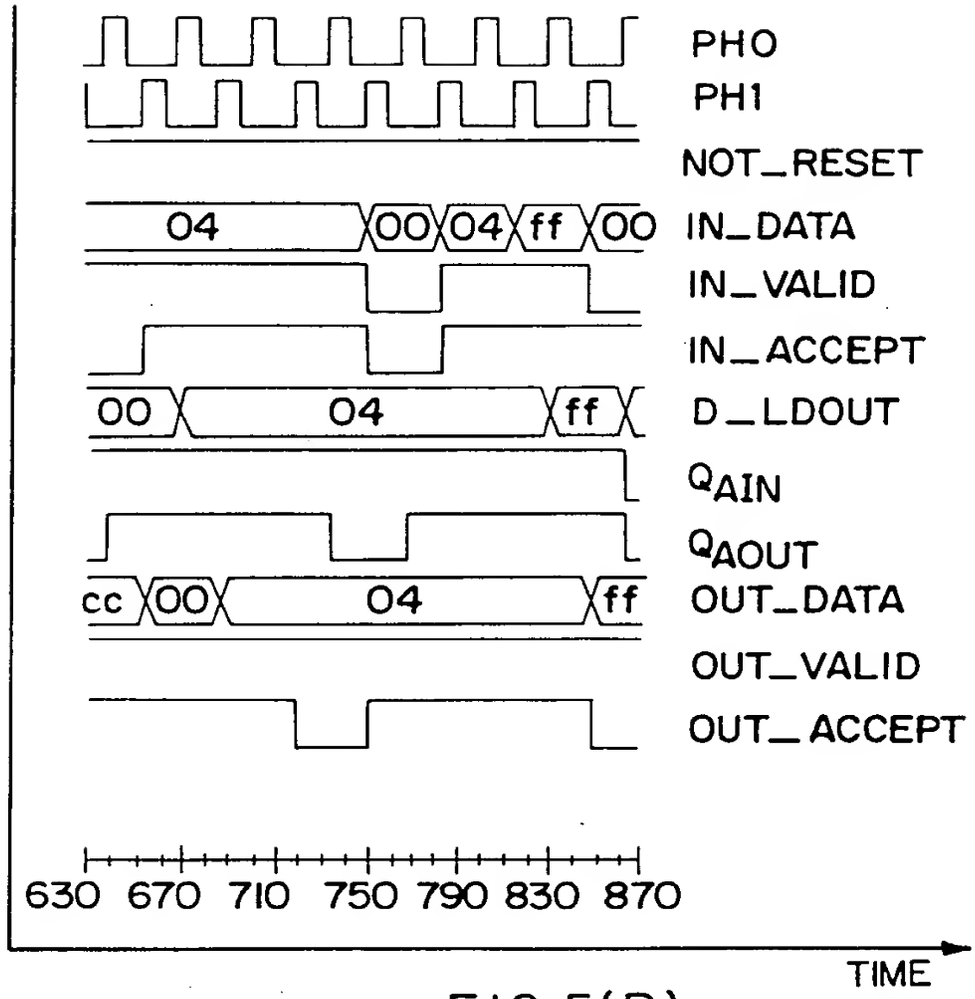


FIG. 5(B)

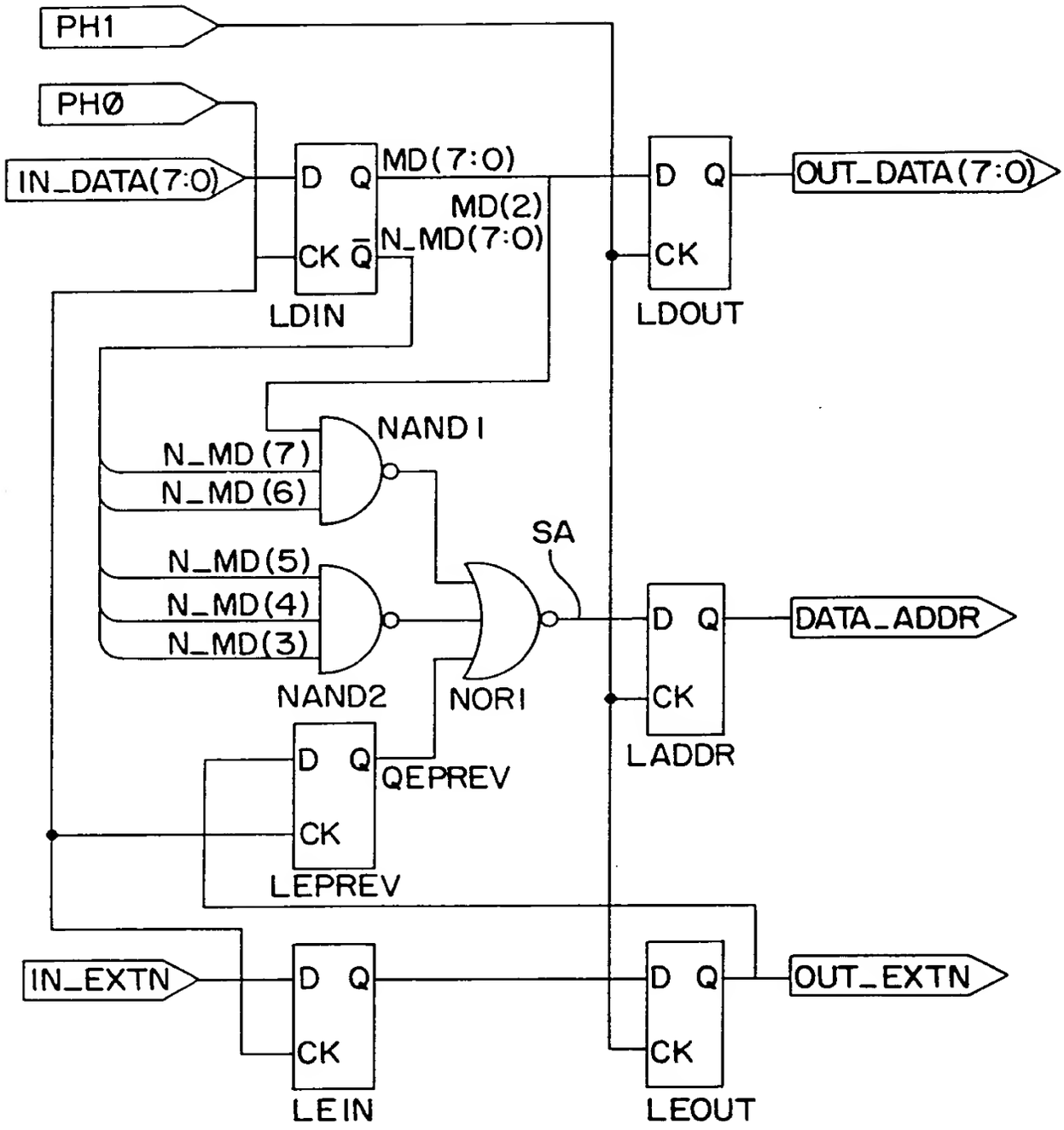

PH1
PHØ
IN_DATA(7:0)
D Q
CK Q̄
LDIN
MD(7:0)
MD(2)
N_MD(7:0)
D Q
CK
LDOUT
OUT_DATA(7:0)
NAND1
N_MD(7)
N_MD(6)
N_MD(5)
N_MD(4)
N_MD(3)
NAND2
SA
NOR1
D Q
CK
LADDR
DATA_ADDR
D Q
QEPREV
CK
LEPREV
IN_EXTN
D Q
CK
LEIN
D Q
CK
LEOUT
OUT_EXTN

FIG. 6

JOT020 EXHE2260

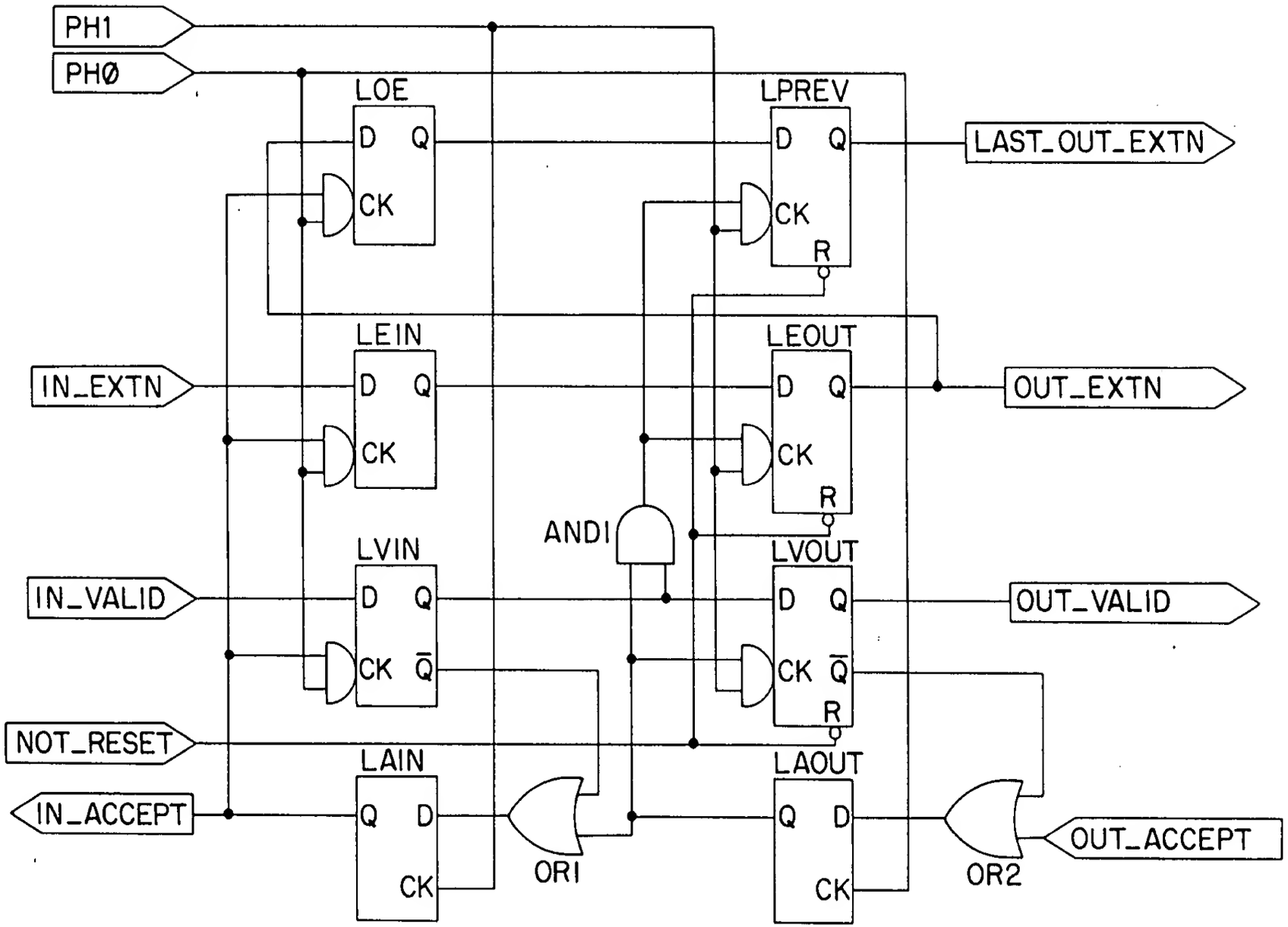


FIG. 7

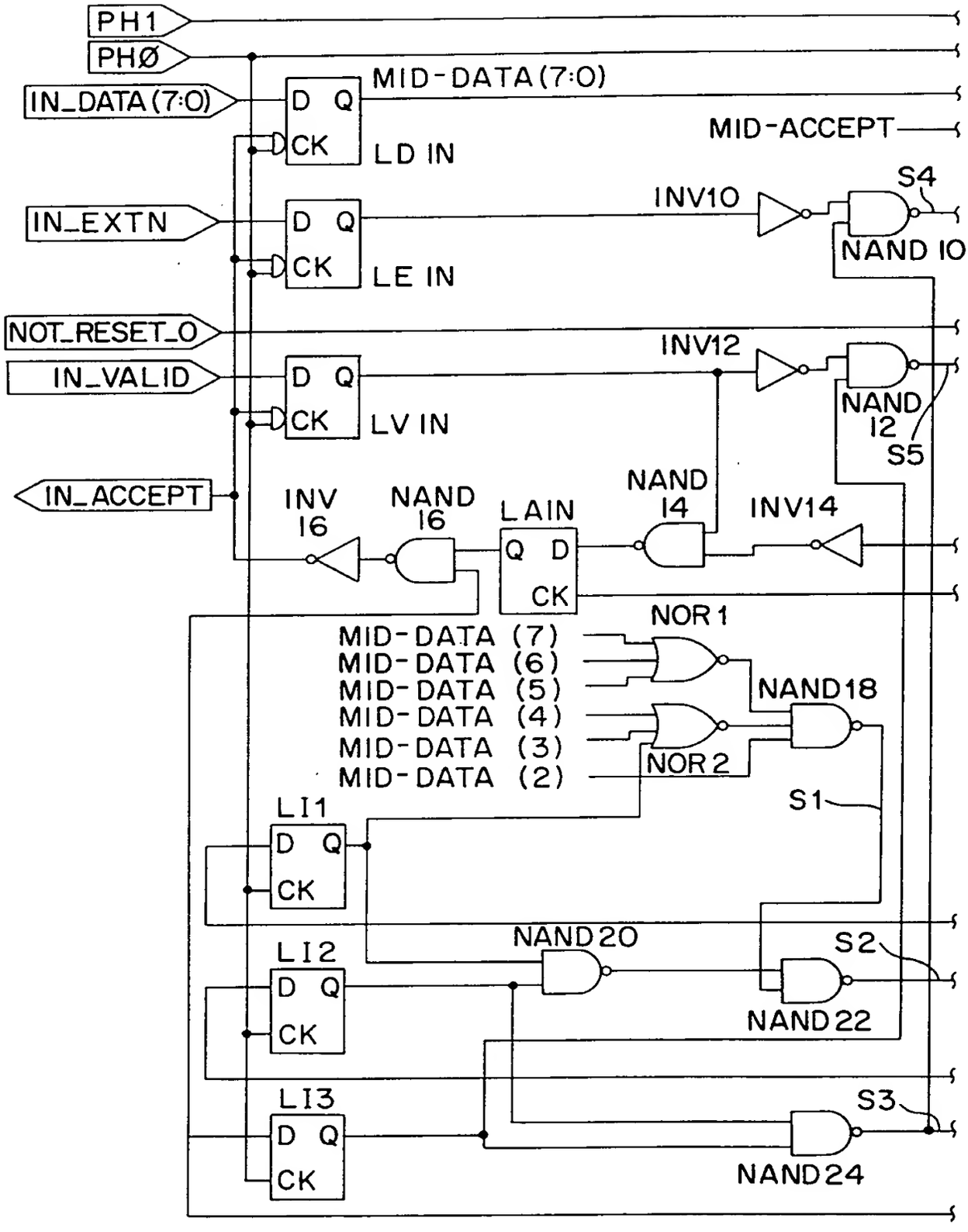

PH1
PHØ
IN_DATA(7:0)
D Q
CK
LD IN
MID-DATA(7:0)
MID-ACCEPT
IN_EXTN
LE IN
INV10
S4
NAND 10
NOT_RESET_O
IN_VALID
LV IN
INV12
NAND 12
S5
IN_ACCEPT
INV 16
NAND 16
LAIN
Q D
NAND 14
INV14
NOR1
MID-DATA (7)
MID-DATA (6)
MID-DATA (5)
MID-DATA (4)
MID-DATA (3)
MID-DATA (2)
NOR2
NAND18
S1
LI1
LI2
LI3
NAND20
S2
NAND22
S3
NAND24

FIG. 8(A)

EP 0 620 520 A2

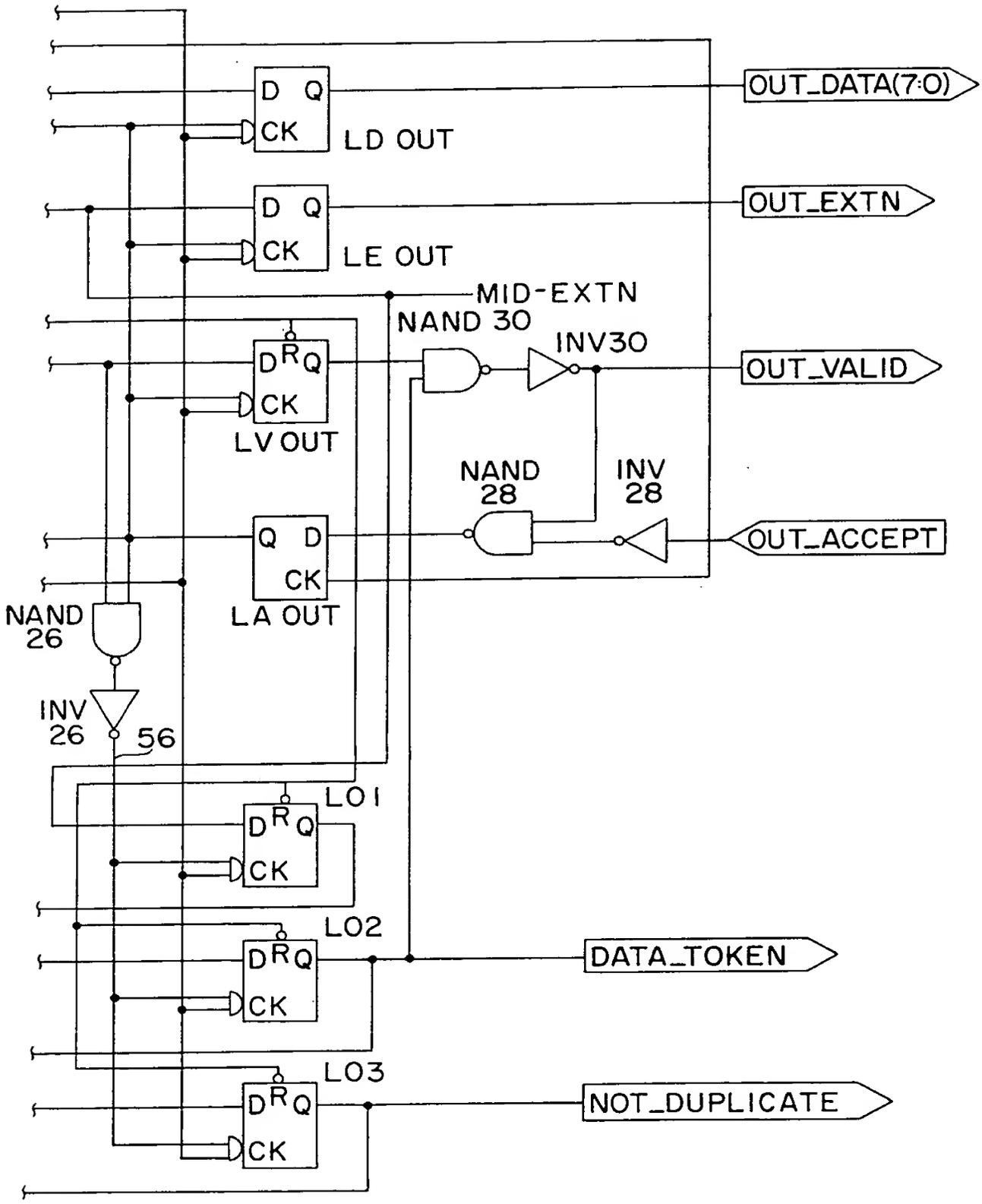


FIG. 8(B)

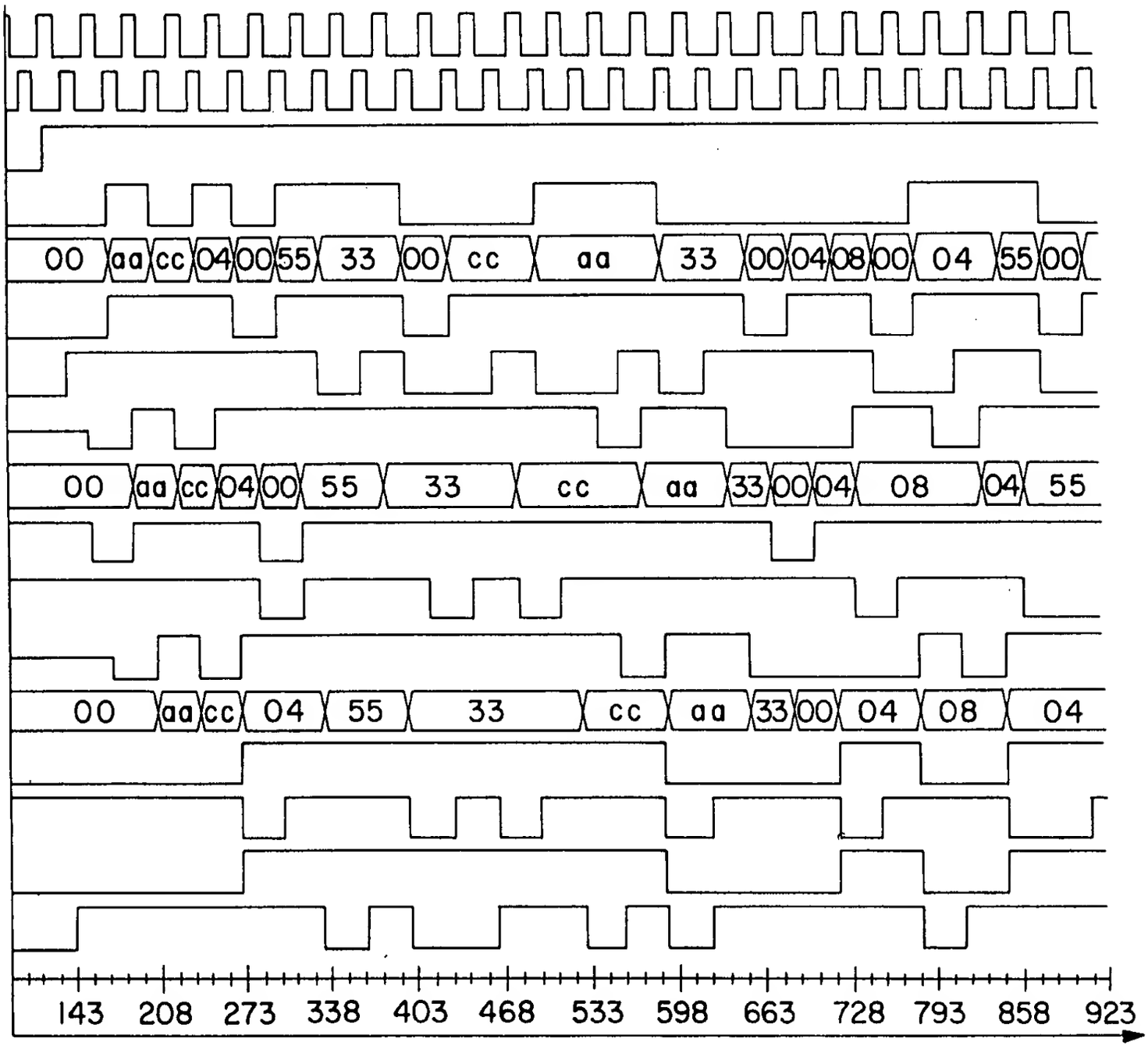

00 aa cc 04 00 55 33 00 cc aa 33 00 04 08 00 04 55 00
00 aa cc 04 00 55 33 cc aa 33 00 04 08 04 55
00 aa cc 04 55 33 cc aa 33 00 04 08 04
143 208 273 338 403 468 533 598 663 728 793 858 923
TIME

FIG. 9(A)

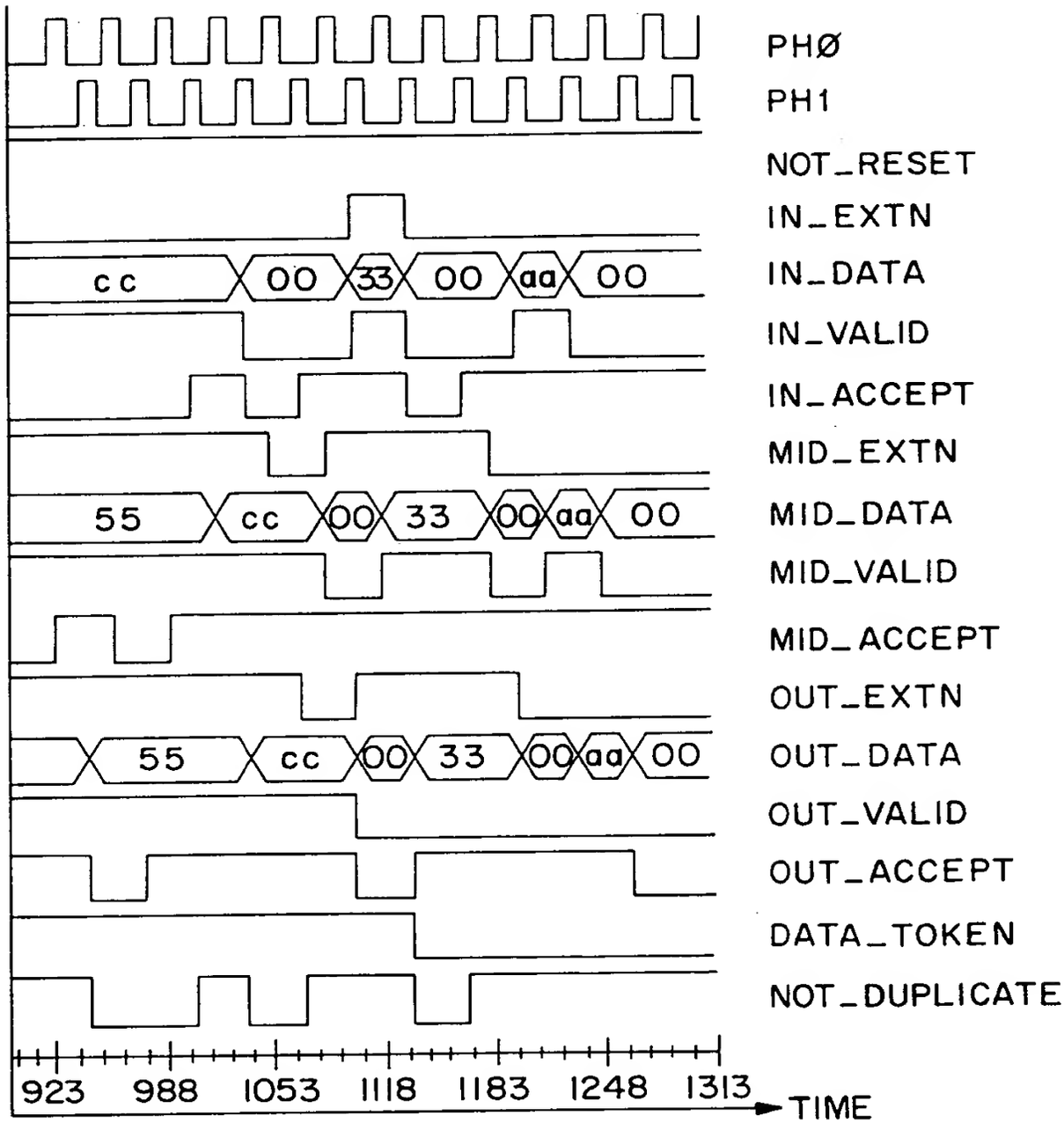

PHØ
PH1
NOT_RESET
IN_EXTN
IN_DATA
IN_VALID
IN_ACCEPT
MID_EXTN
MID_DATA
MID_VALID
MID_ACCEPT
OUT_EXTN
OUT_DATA
OUT_VALID
OUT_ACCEPT
DATA_TOKEN
NOT_DUPLICATE
cc 00 33 00 aa 00
55 cc 00 33 00 aa 00
55 cc 00 33 00 aa 00
923 988 1053 1118 1183 1248 1313
TIME

FIG. 9(B)

EP 0 040 626 B1

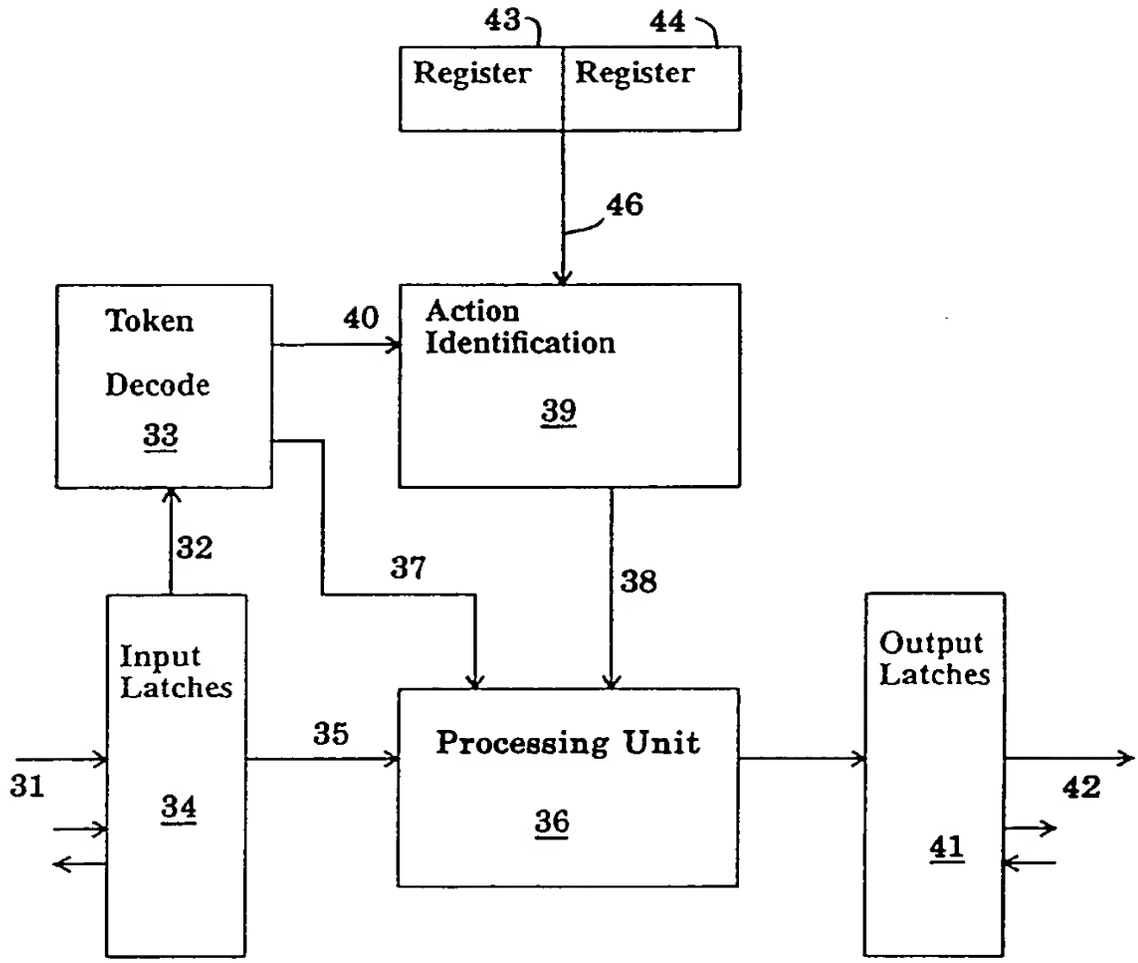


FIG. 10

EP 0 720 380 A2

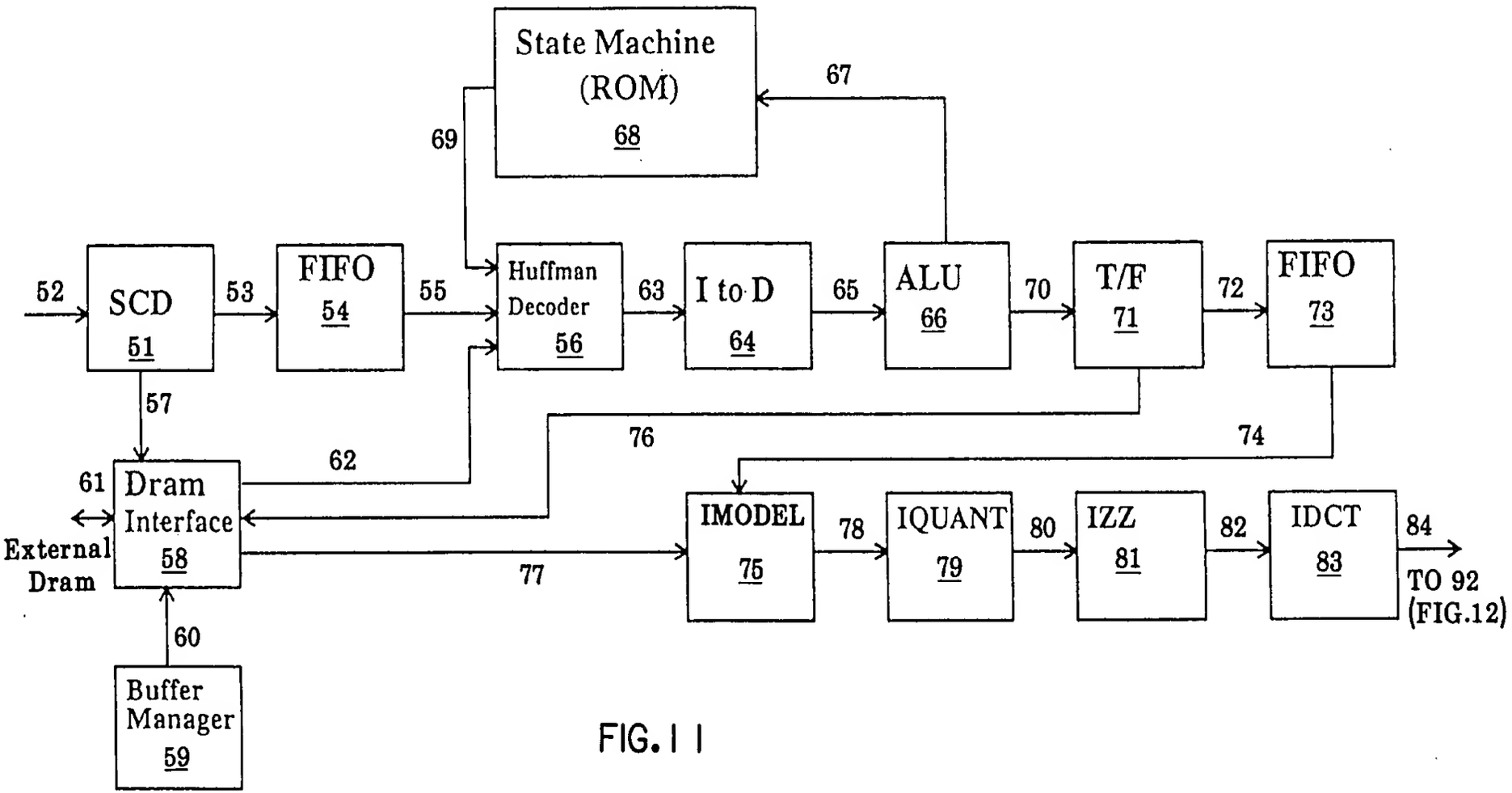


FIG. 11

TOTO20 "E2HE2260

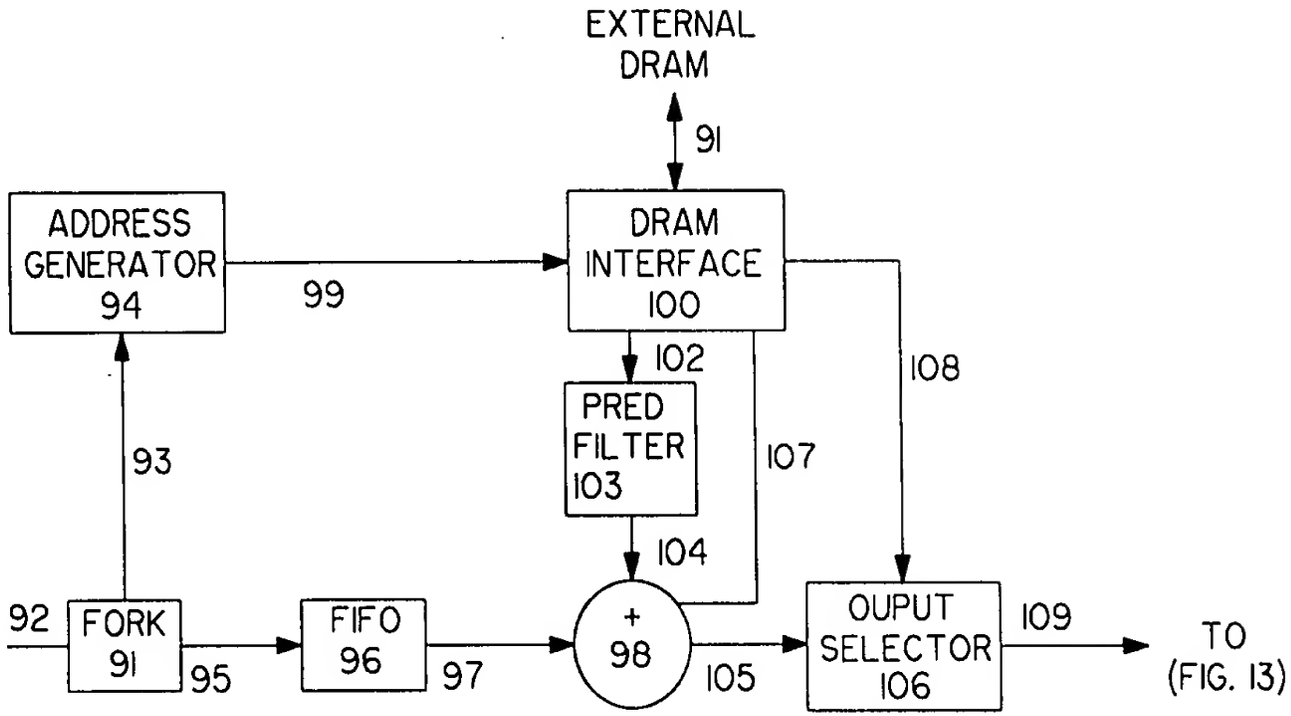


FIG. 12

TOTO20 "E7hE2260

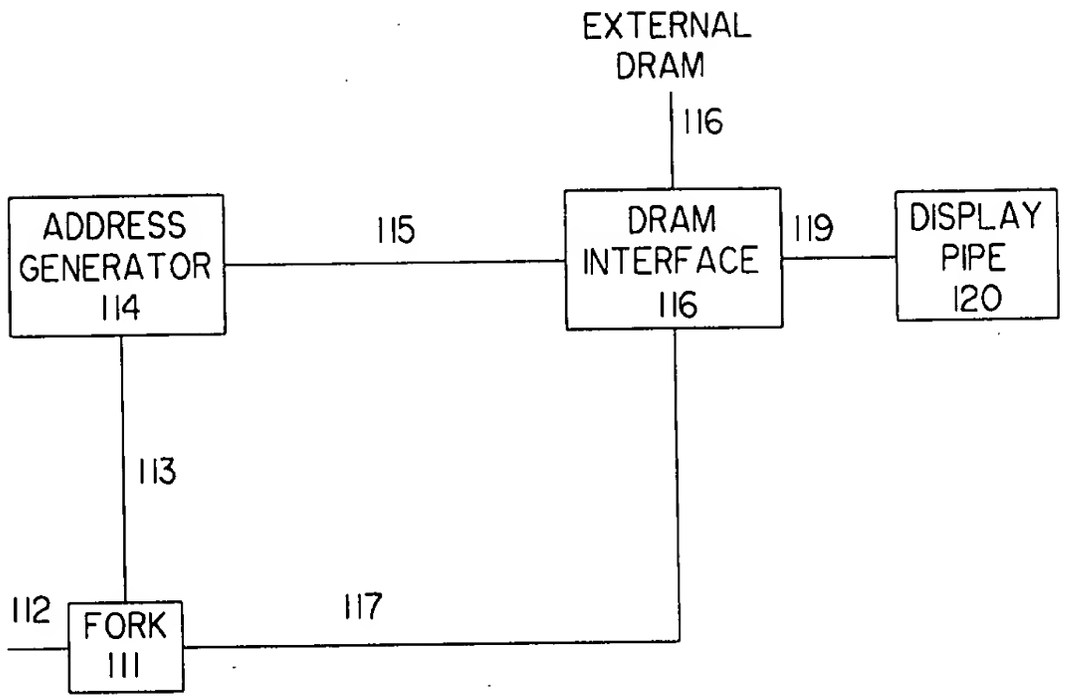


FIG. 13

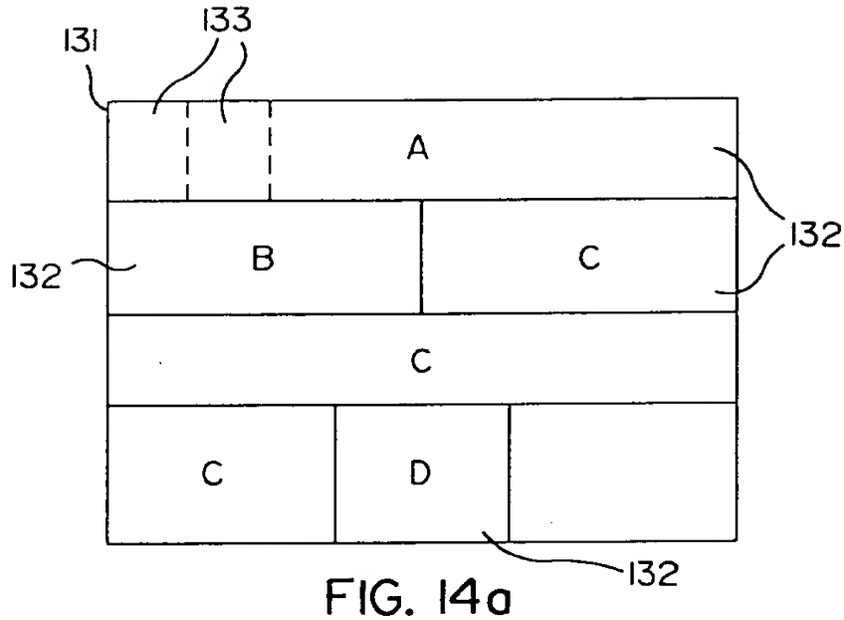


FIG. 14a

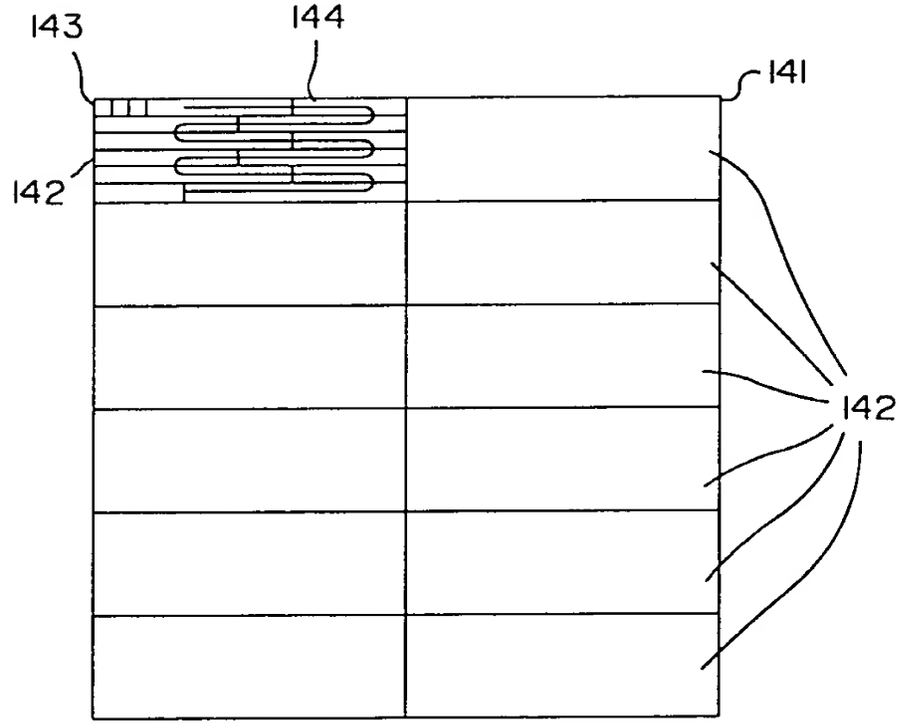


FIG. 14b

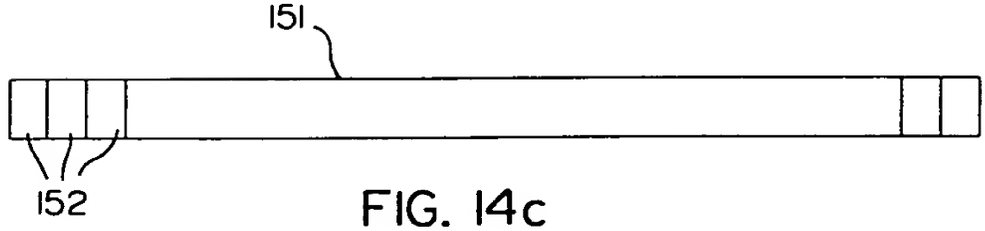


FIG. 14c

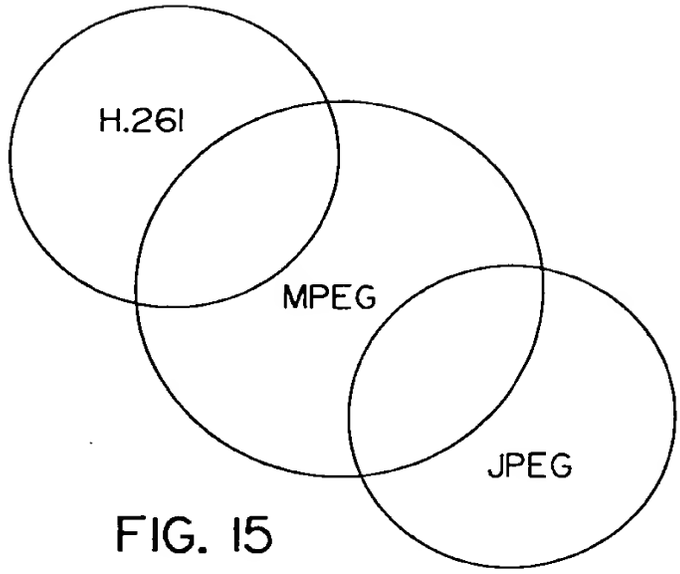

H.261
MPEG
JPEG

FIG. 15

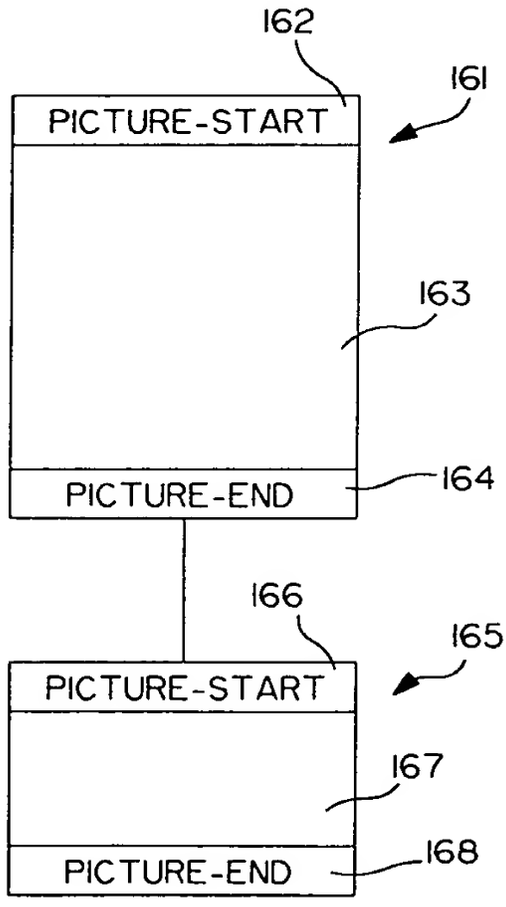

162
161
PICTURE-START
163
PICTURE-END
164
166
165
PICTURE-START
167
PICTURE-END
168

FIG. 16

TOTO20 E2HE260

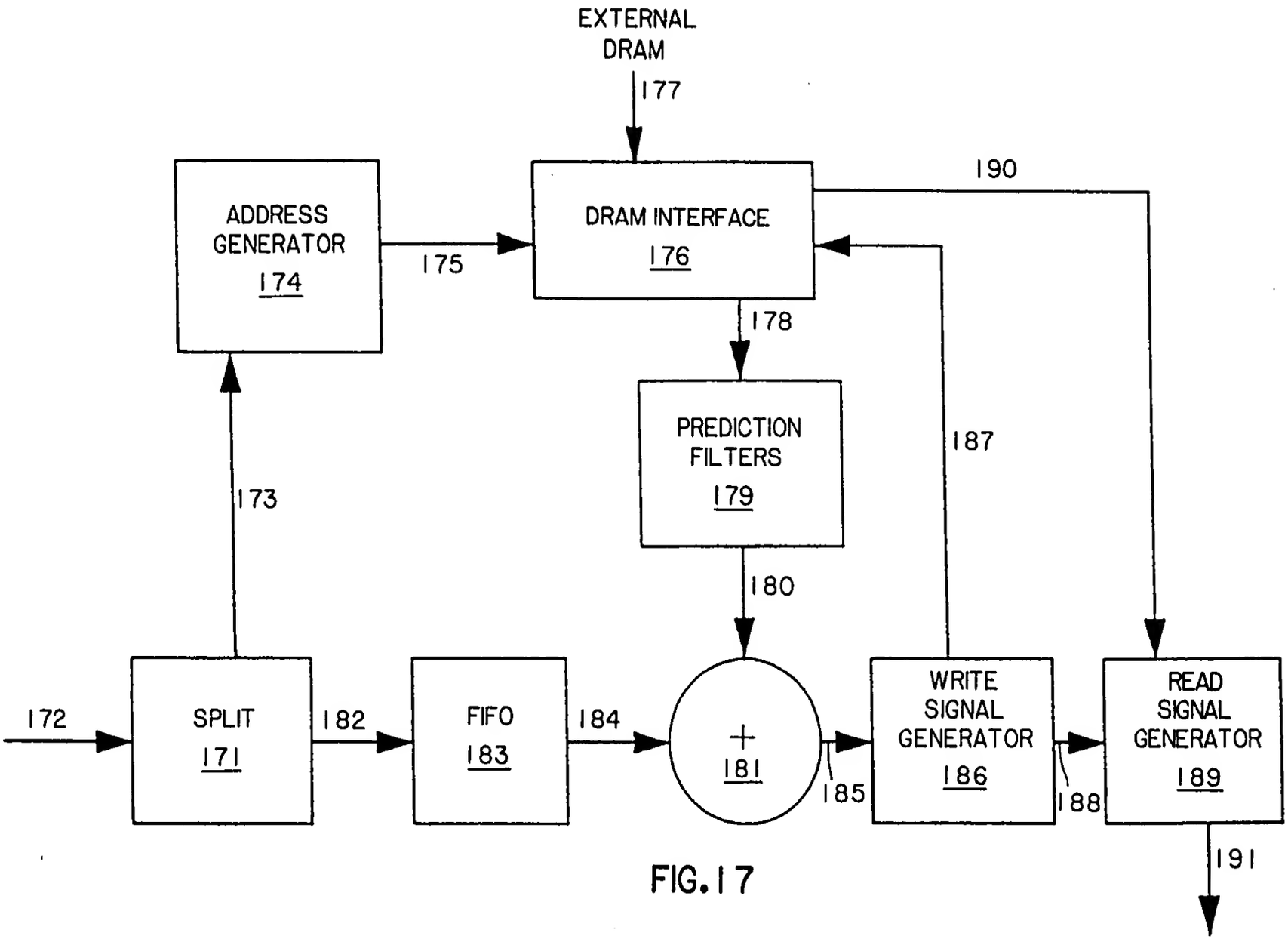


FIG. 17

EP 0 720 020 A2

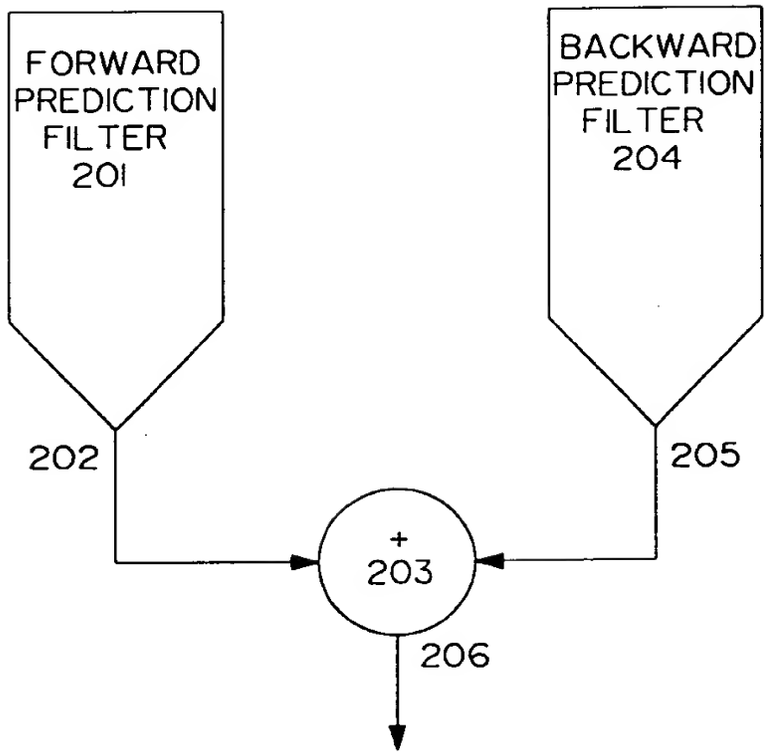


FIG. 18

EP 0 720 380 A2

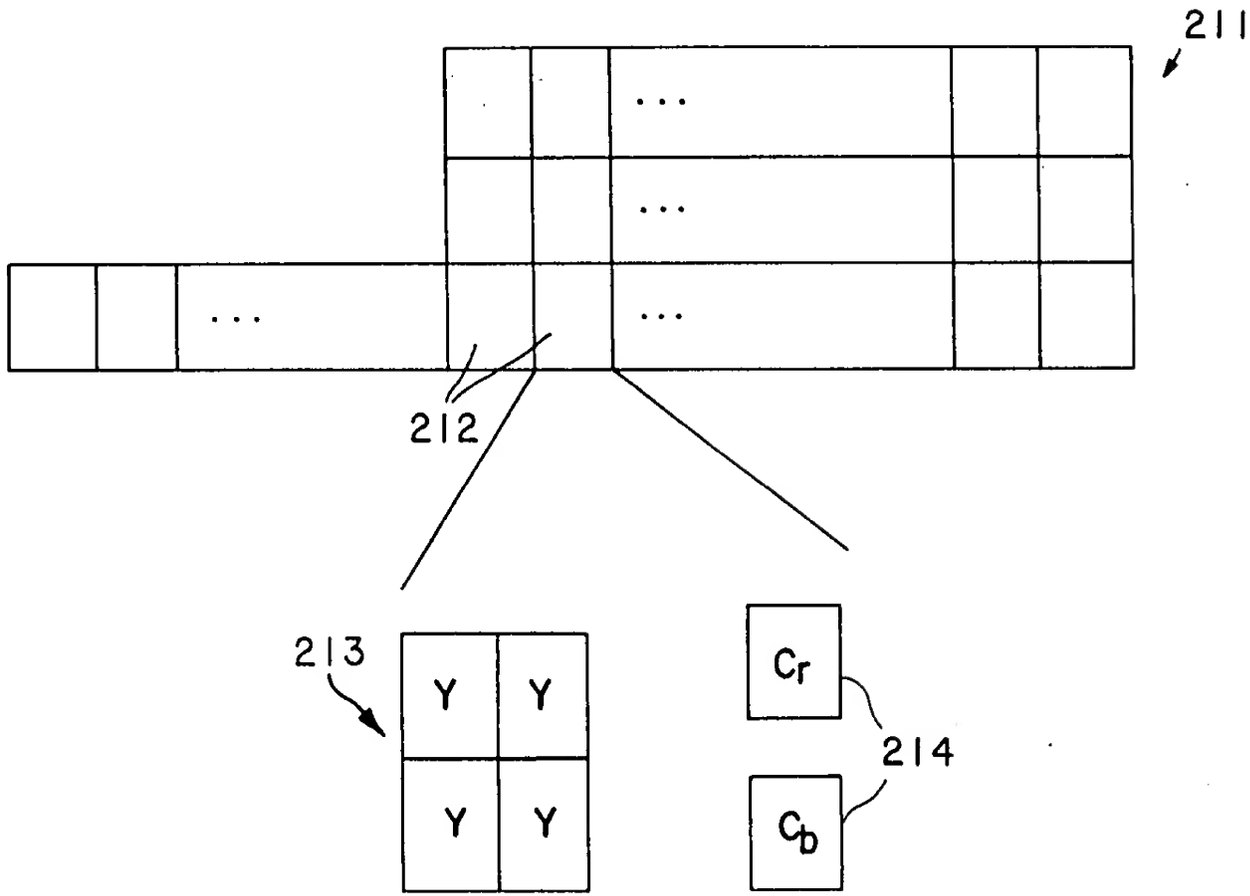


FIG. 19

TOTO20 "E2HE2260

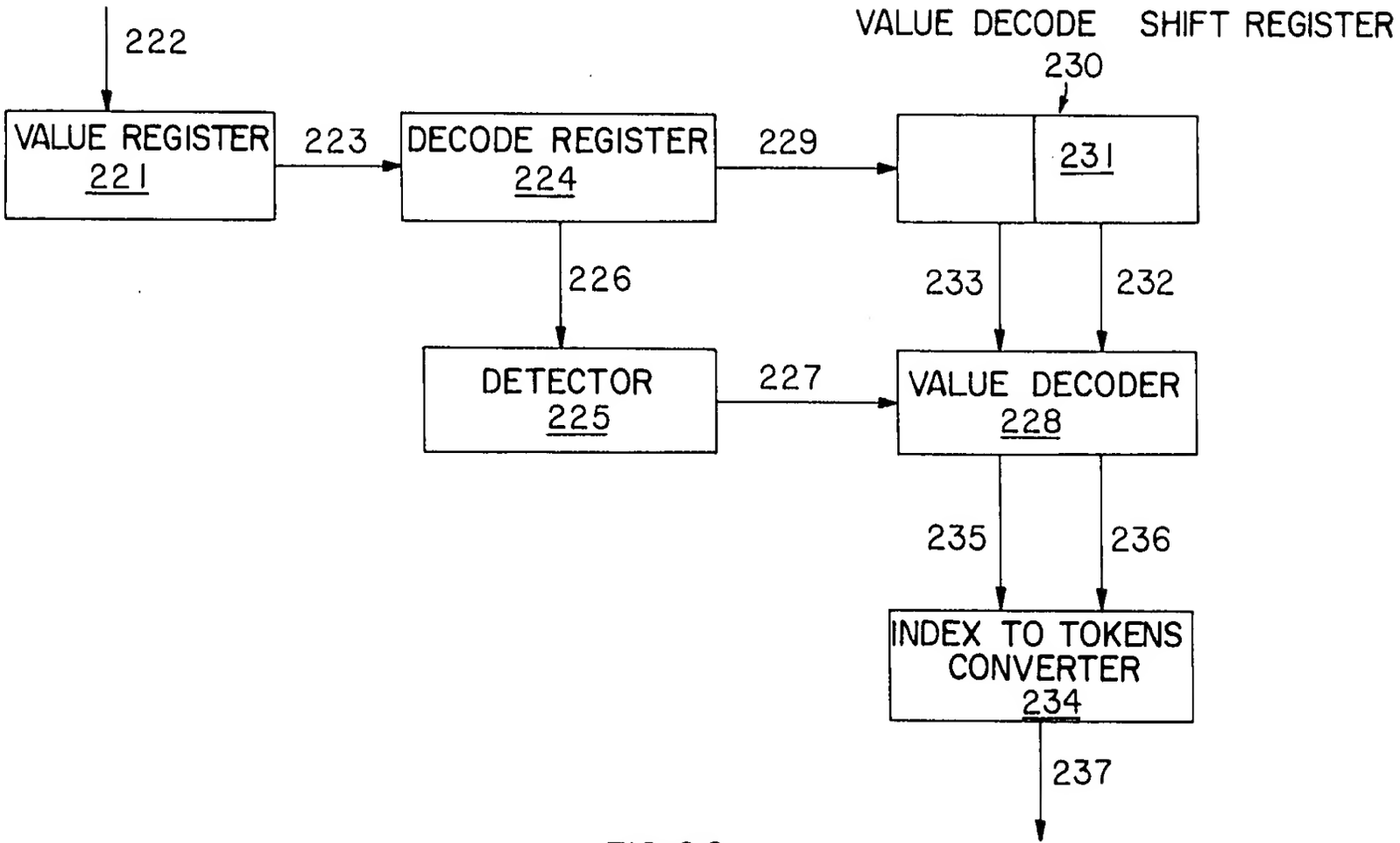


FIG.20

FOTO20 "Z4hZZ60

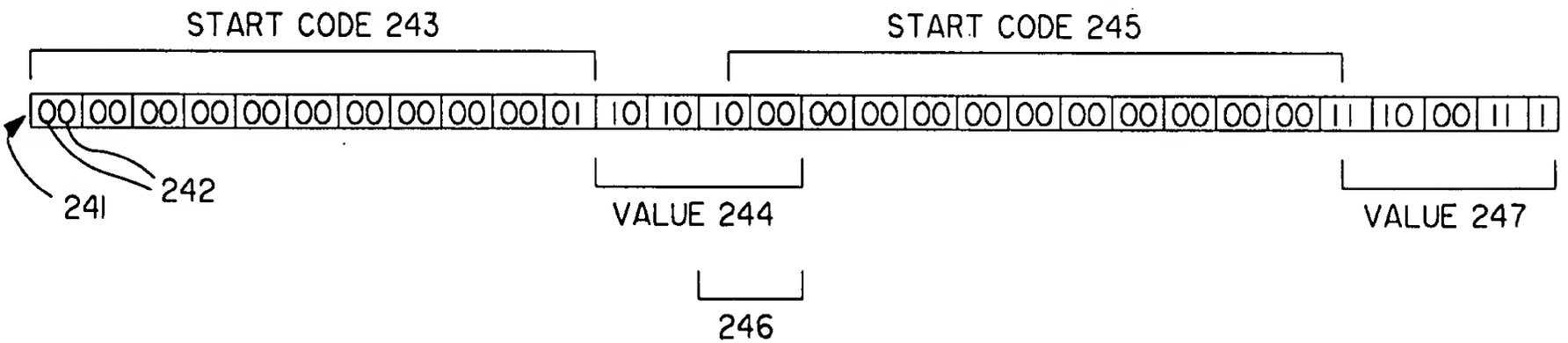


FIG. 21

TOTO20" E2hE2260

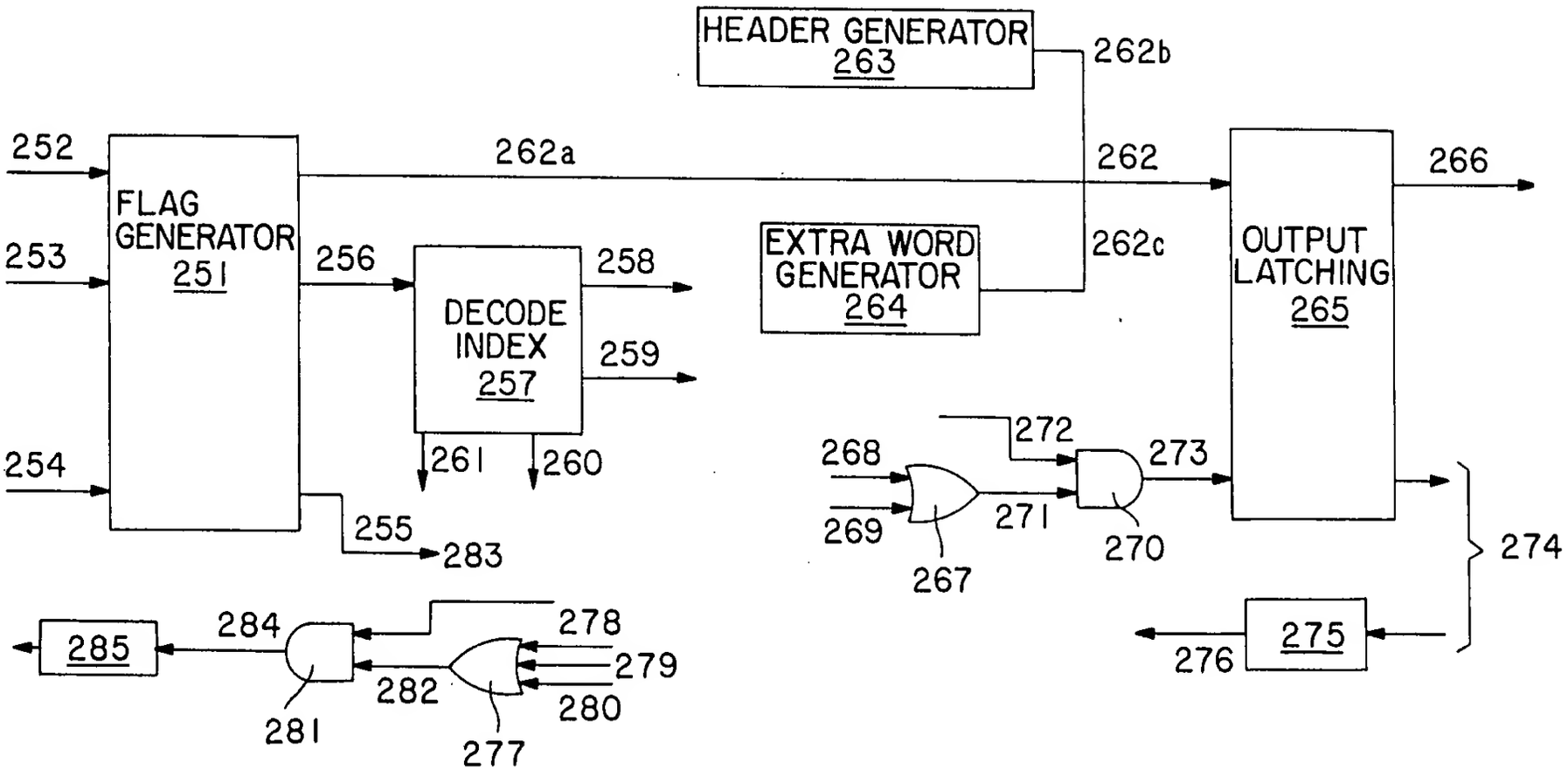


FIG.22

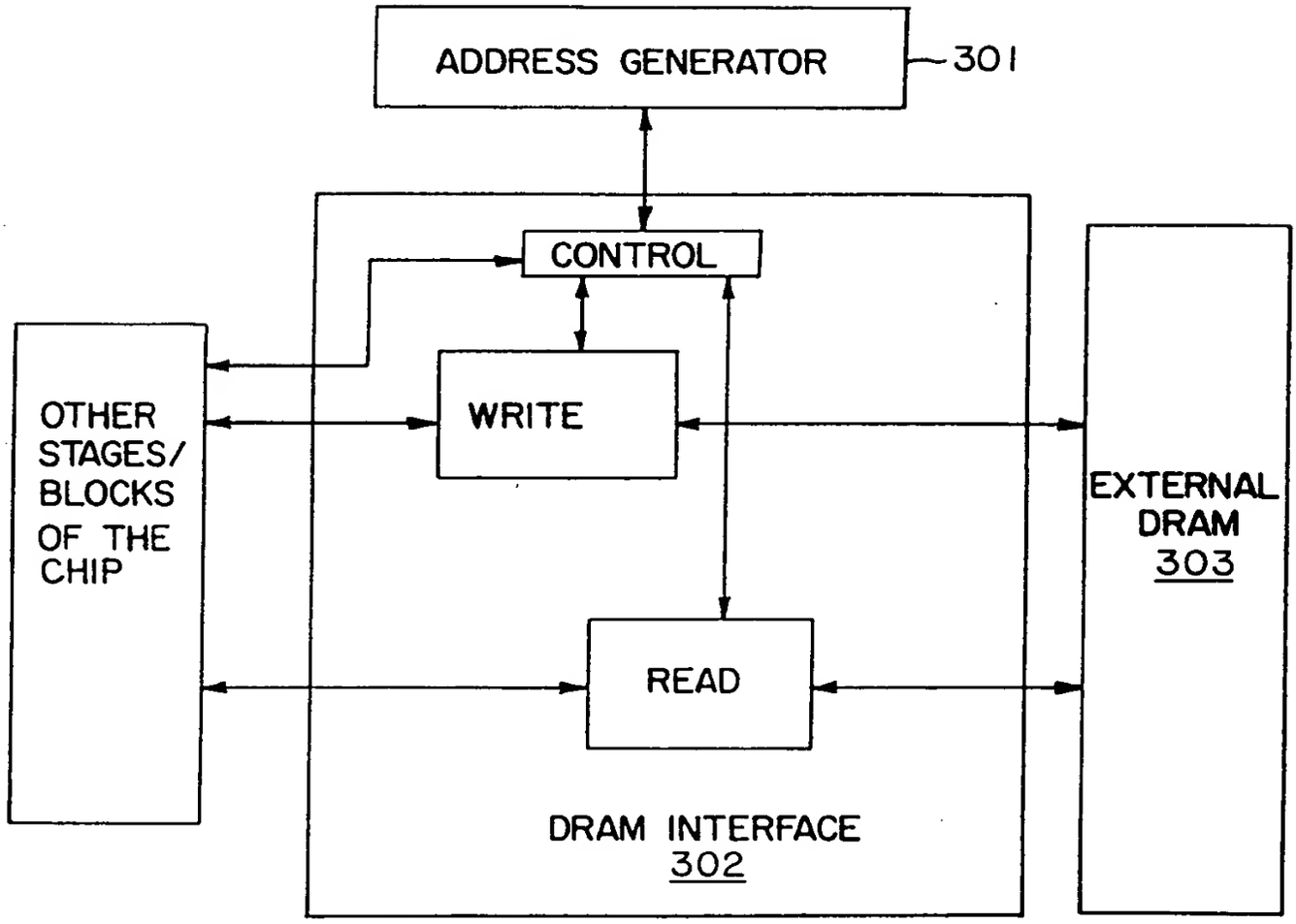

ADDRESS GENERATOR
301
CONTROL
WRITE
READ
OTHER STAGES/ BLOCKS OF THE CHIP
EXTERNAL DRAM 303
DRAM INTERFACE 302

FIG.23

FOTO20" SCHEZZ60

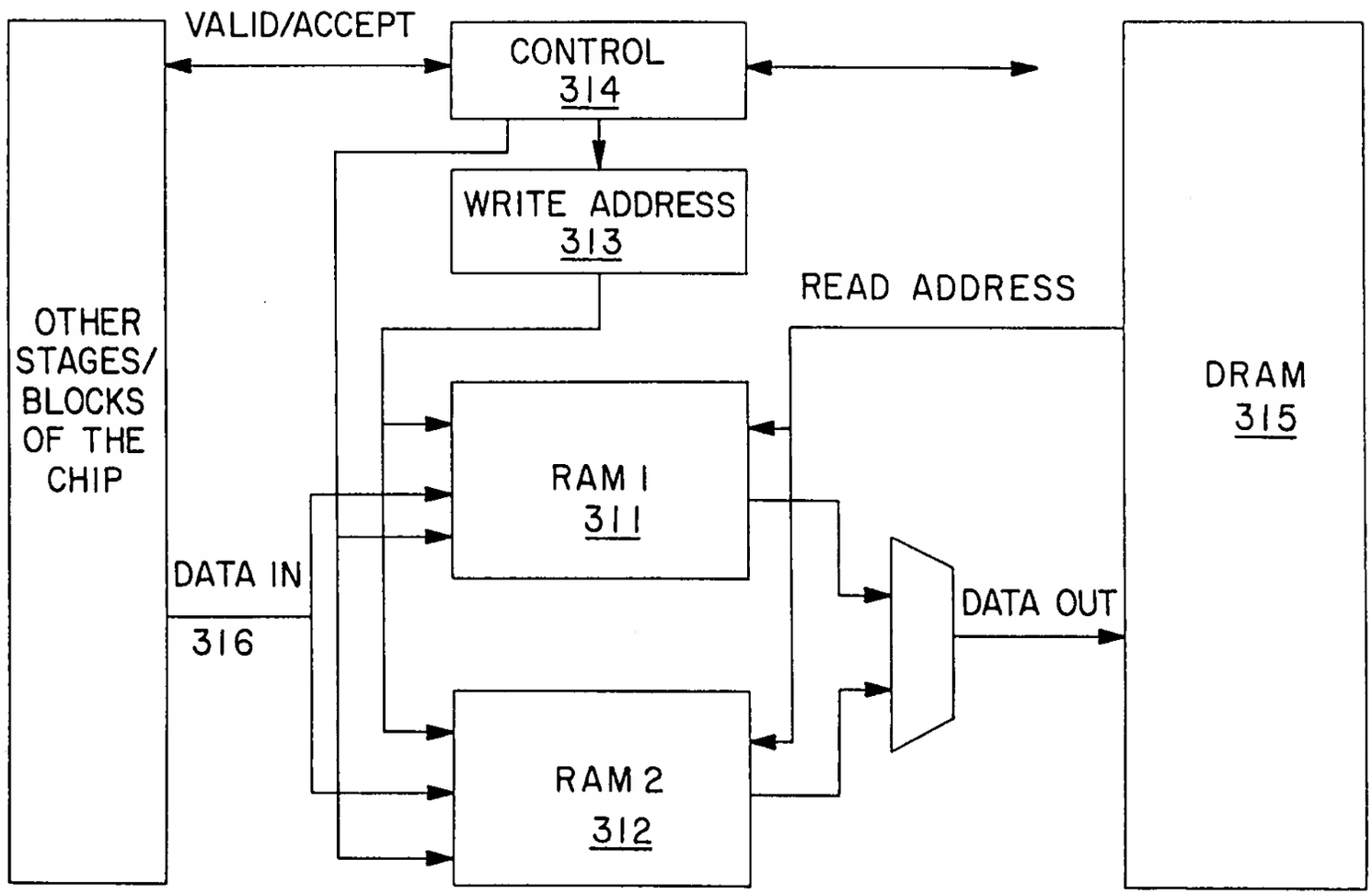


FIG.24

EP 0 696 020 A2

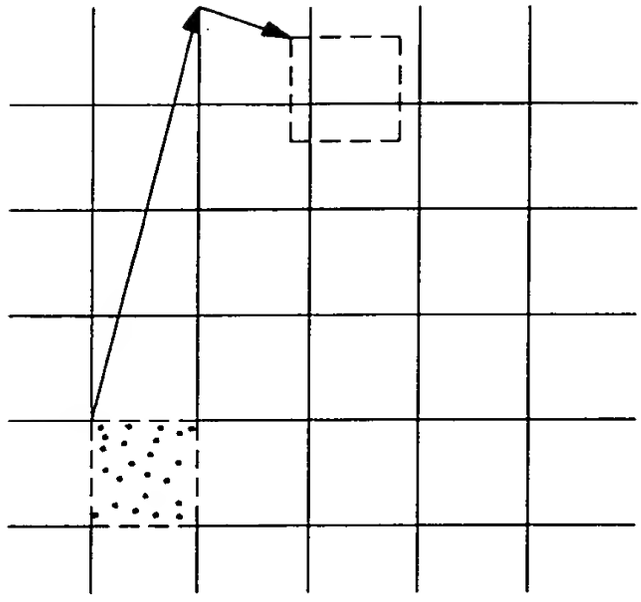


FIG. 25

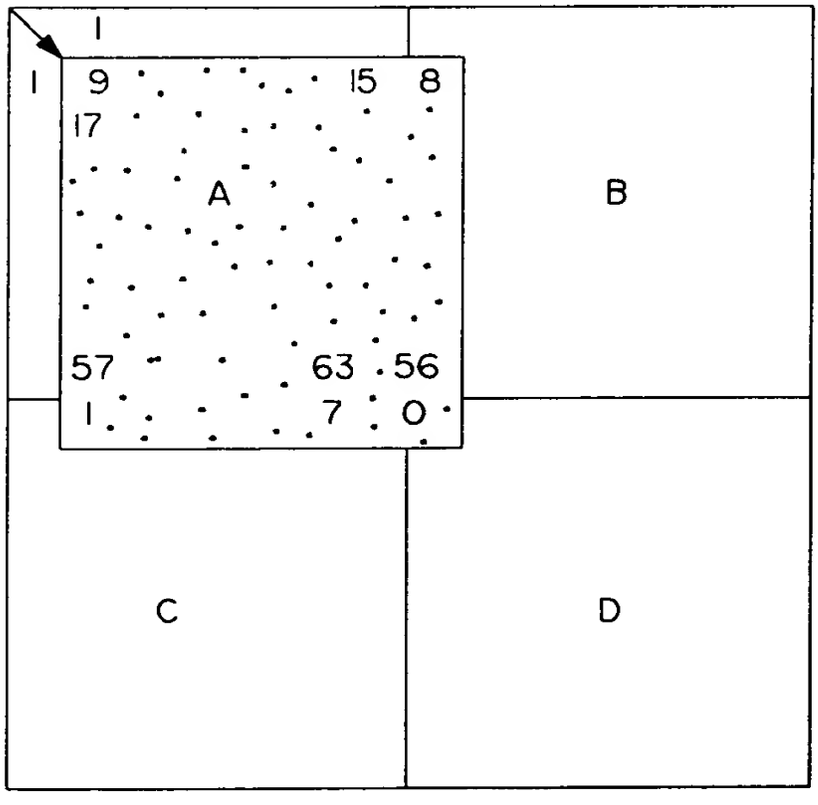


FIG. 26

TOTO20 "2418260

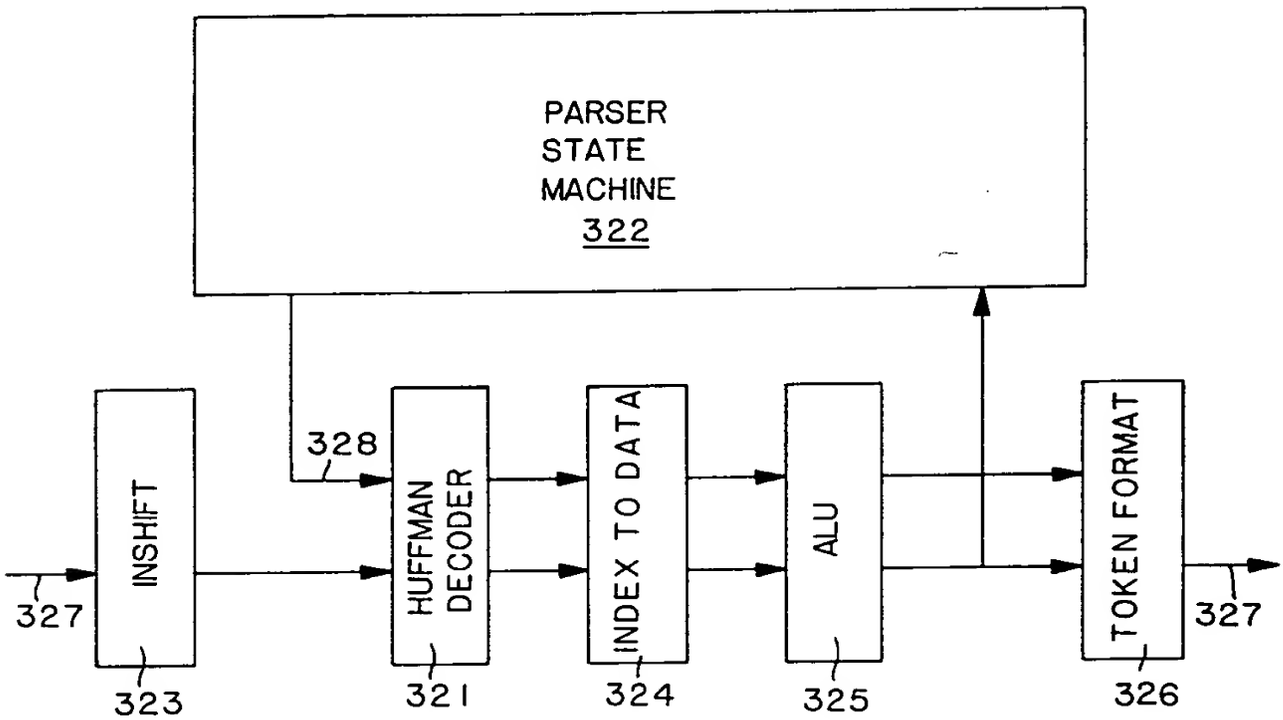


FIG.27

EP 0 542 260 A2

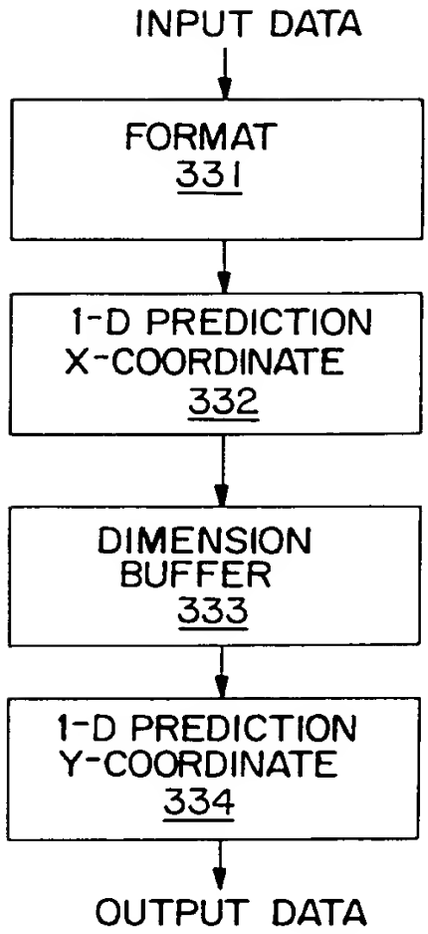


FIG.28

EP 0 625 269 B1

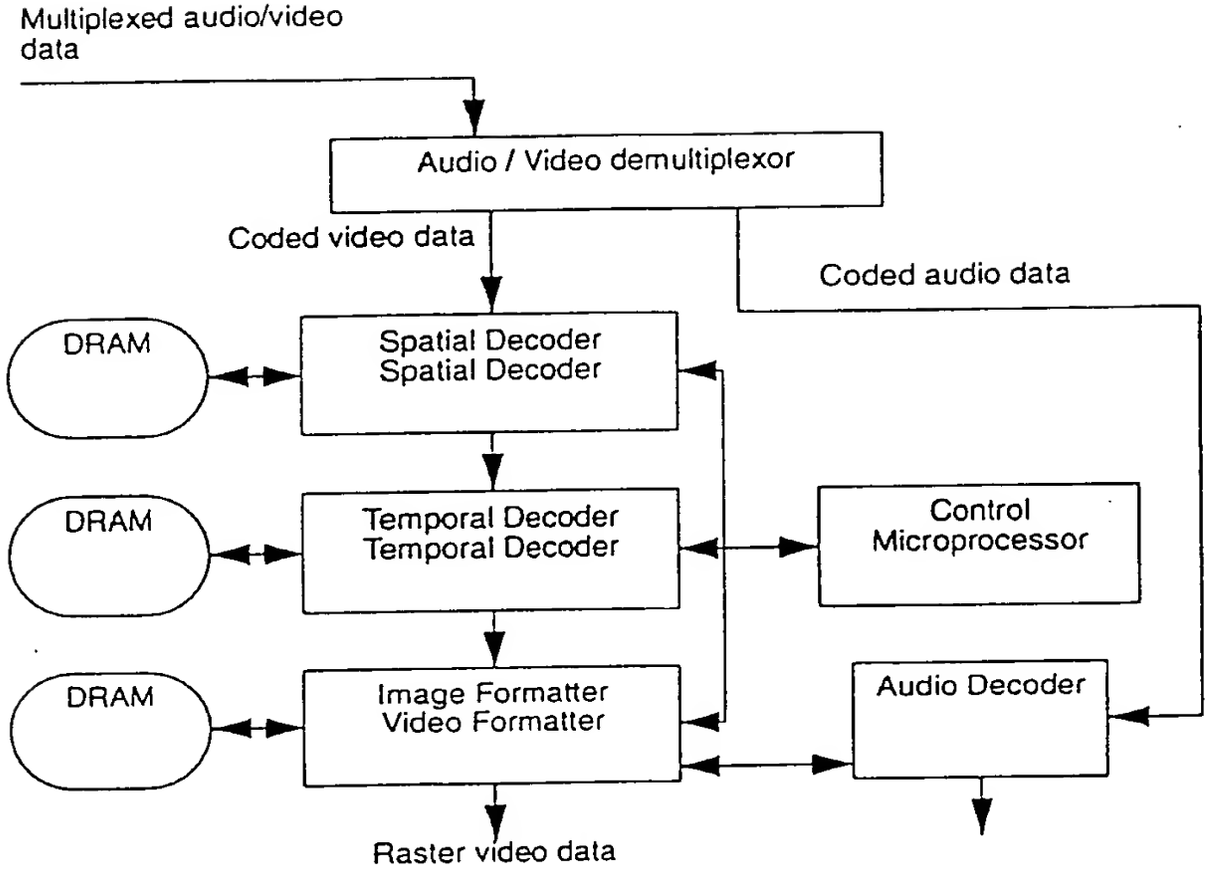


FIG.29

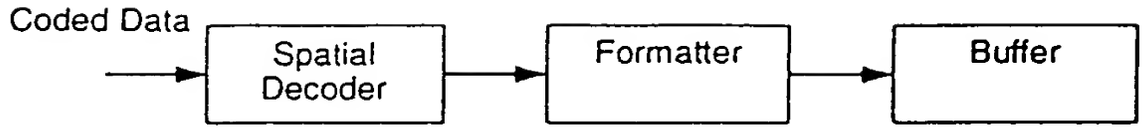


FIG.30

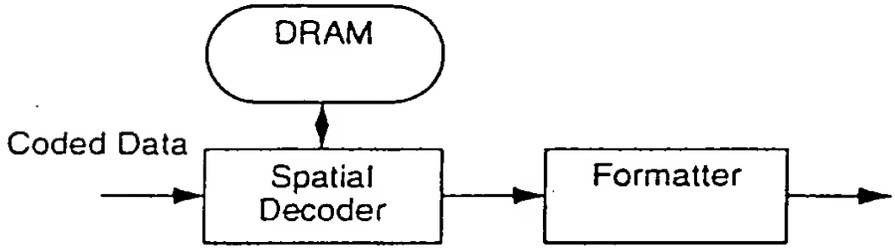


FIG.31

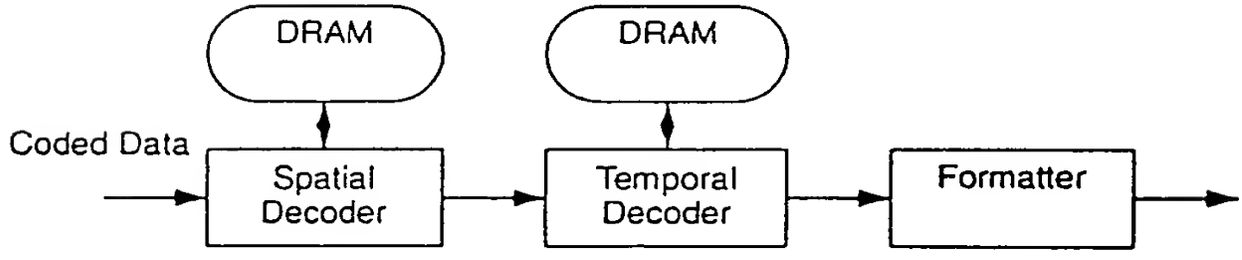


FIG.32

EP 0 620 520 A2

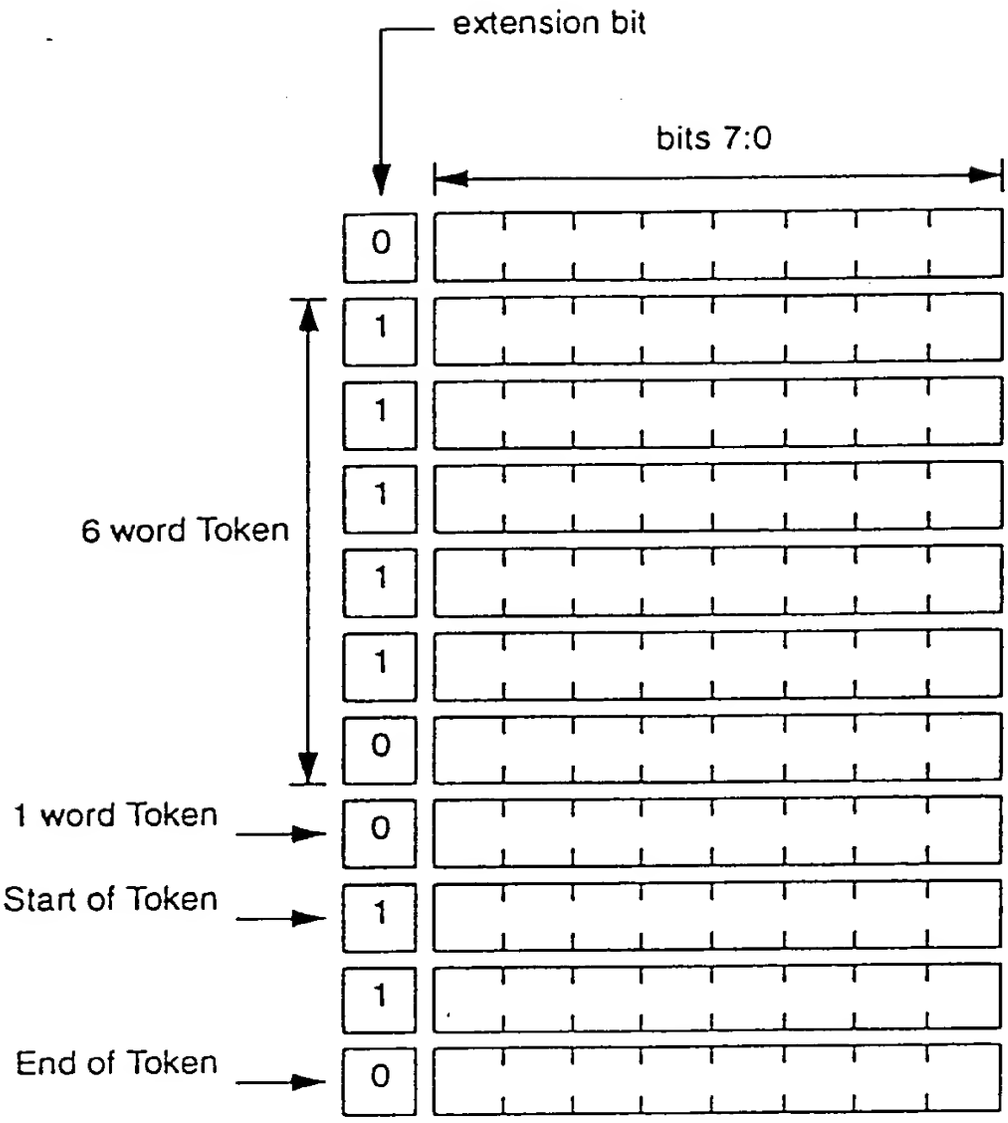


FIG.33

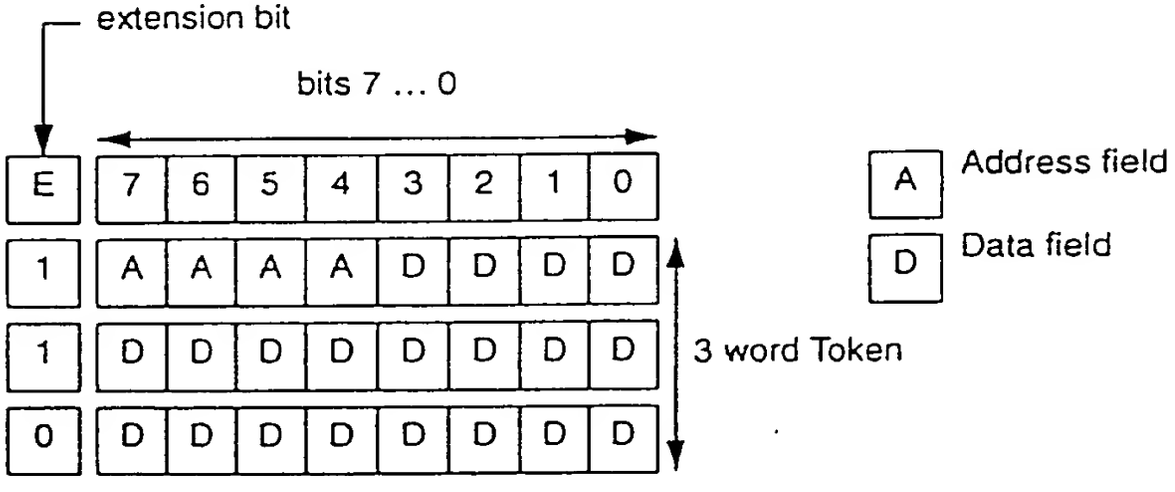


FIG.34

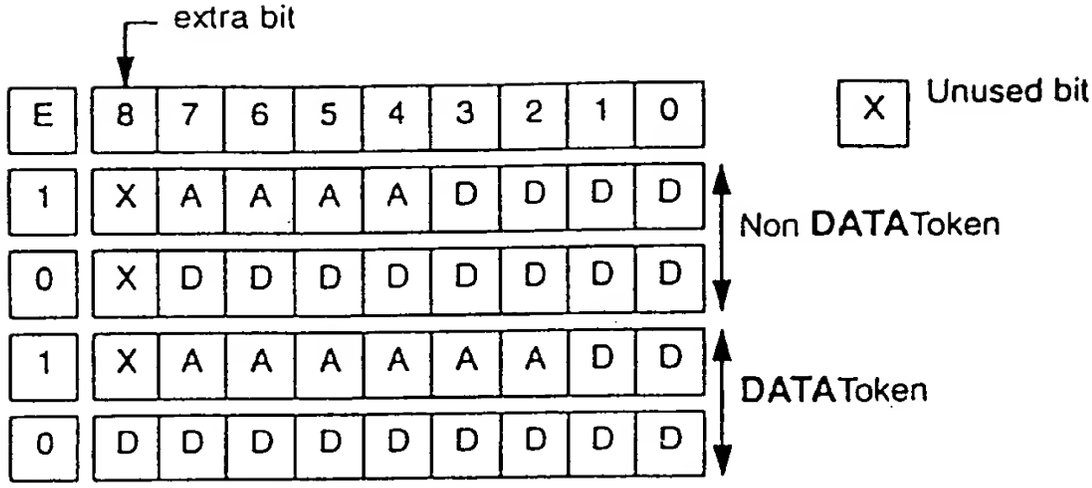
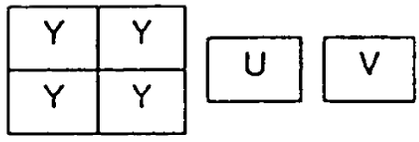


FIG.35



MPEG 4:2:0
macroblock

FIG.36A

JPEG 2:1:1
macroblock

FIG.36B

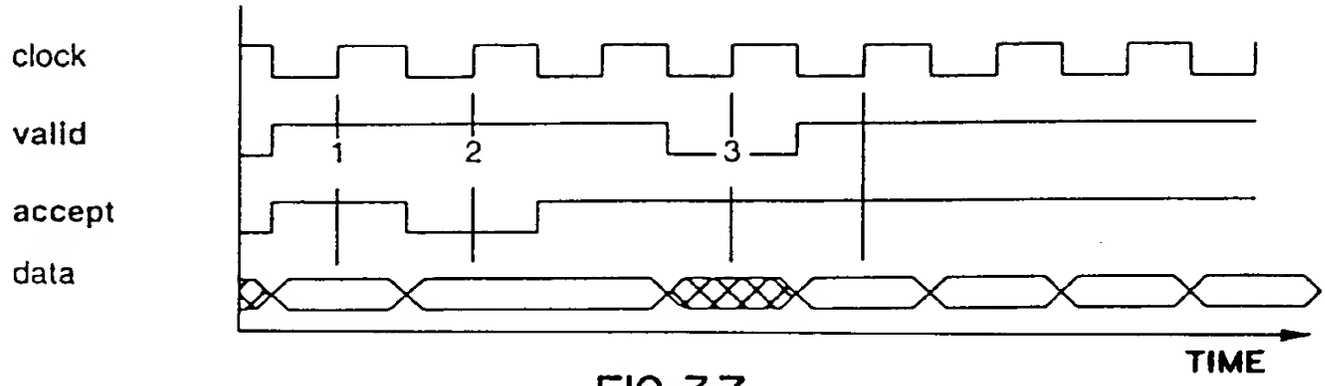

clock
valid
accept
data
1
2
3
TIME

FIG.37

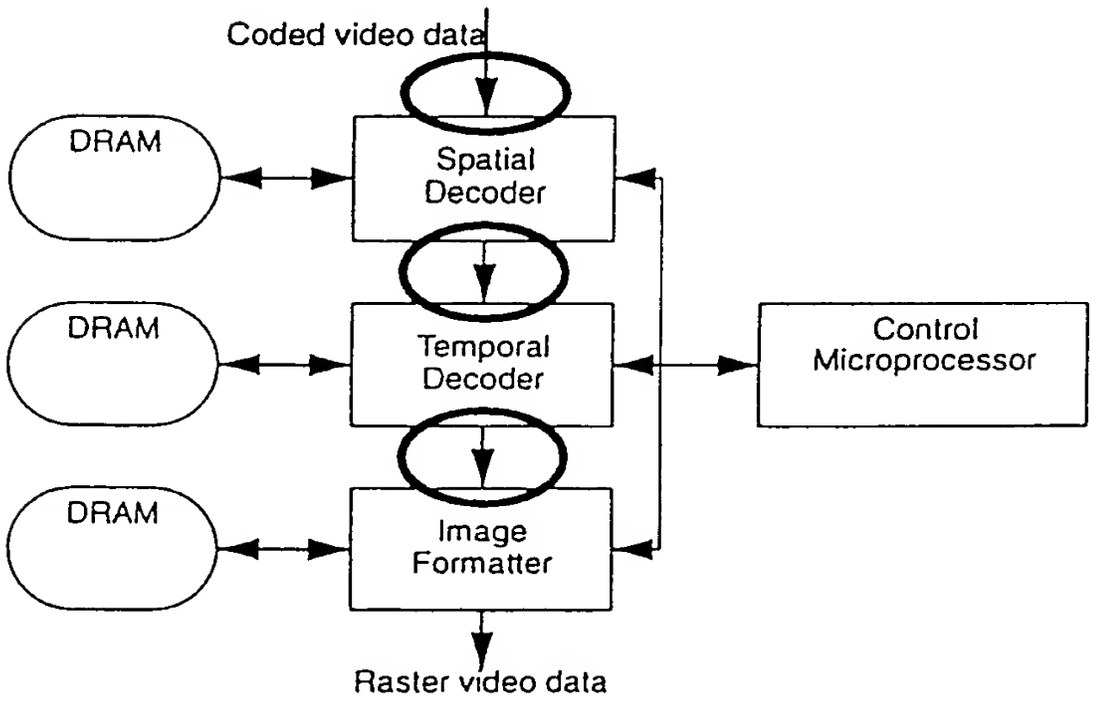

Coded video data
DRAM
Spatial Decoder
DRAM
Temporal Decoder
Control Microprocessor
DRAM
Image Formatter
Raster video data

FIG.38

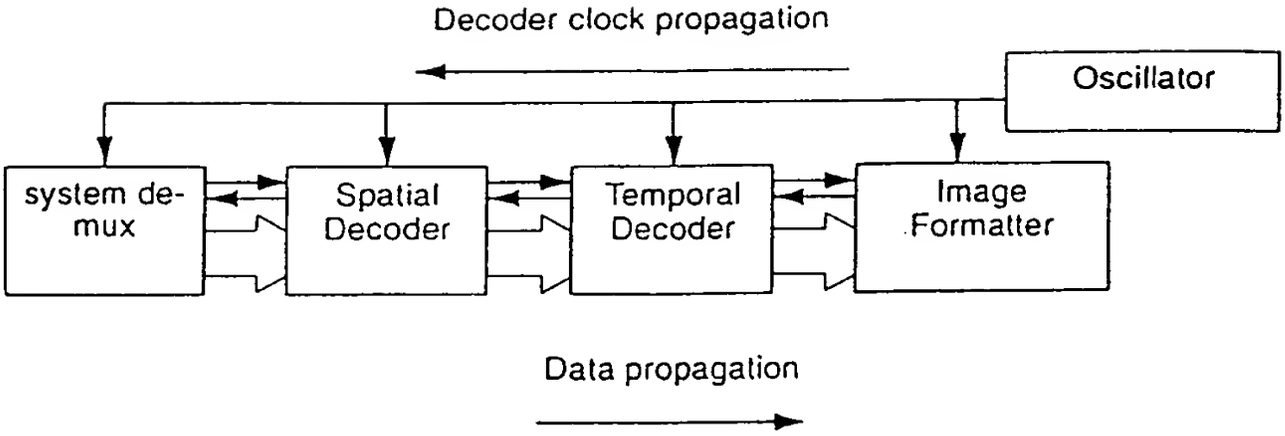

Decoder clock propagation
Oscillator
system de-mux
Spatial Decoder
Temporal Decoder
Image Formatter
Data propagation

FIG.39

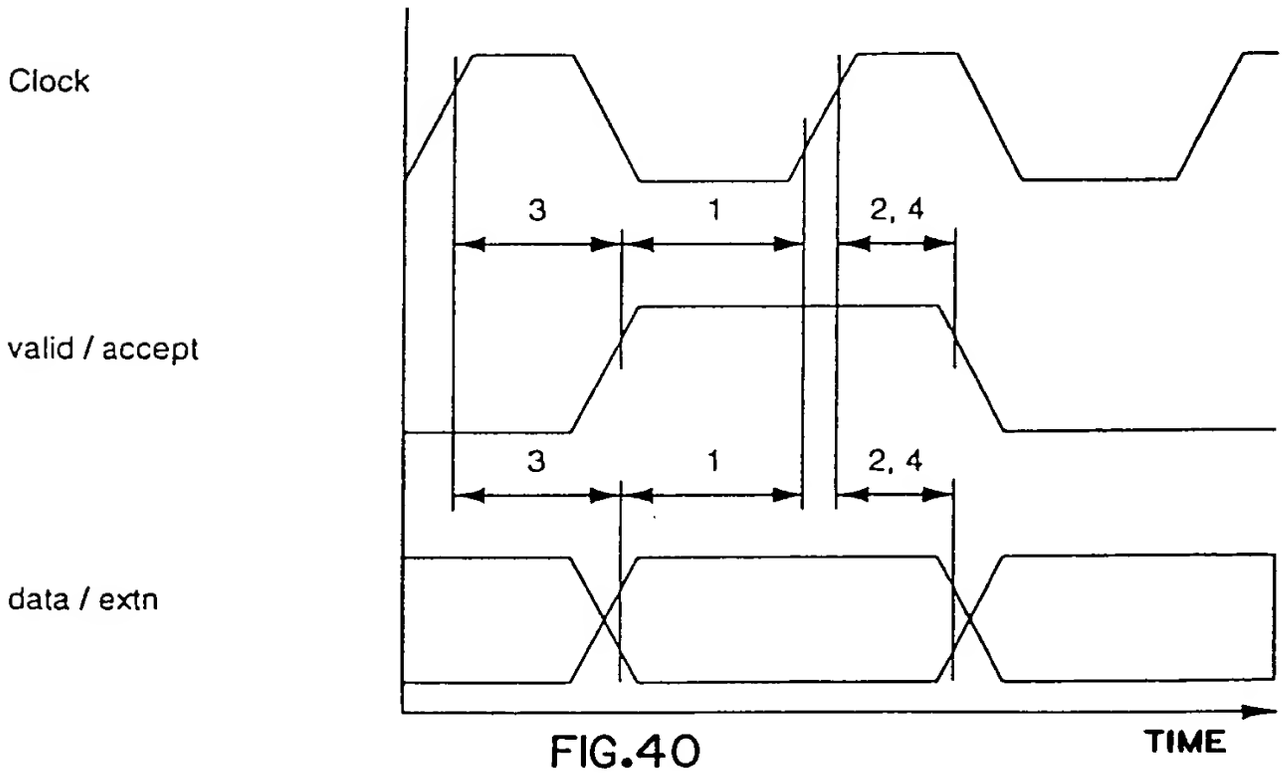

Clock
valid / accept
data / extn
3
1
2, 4
3
1
2, 4
TIME

FIG.40

Access Start
Data Transfer
Default State

FIG.41

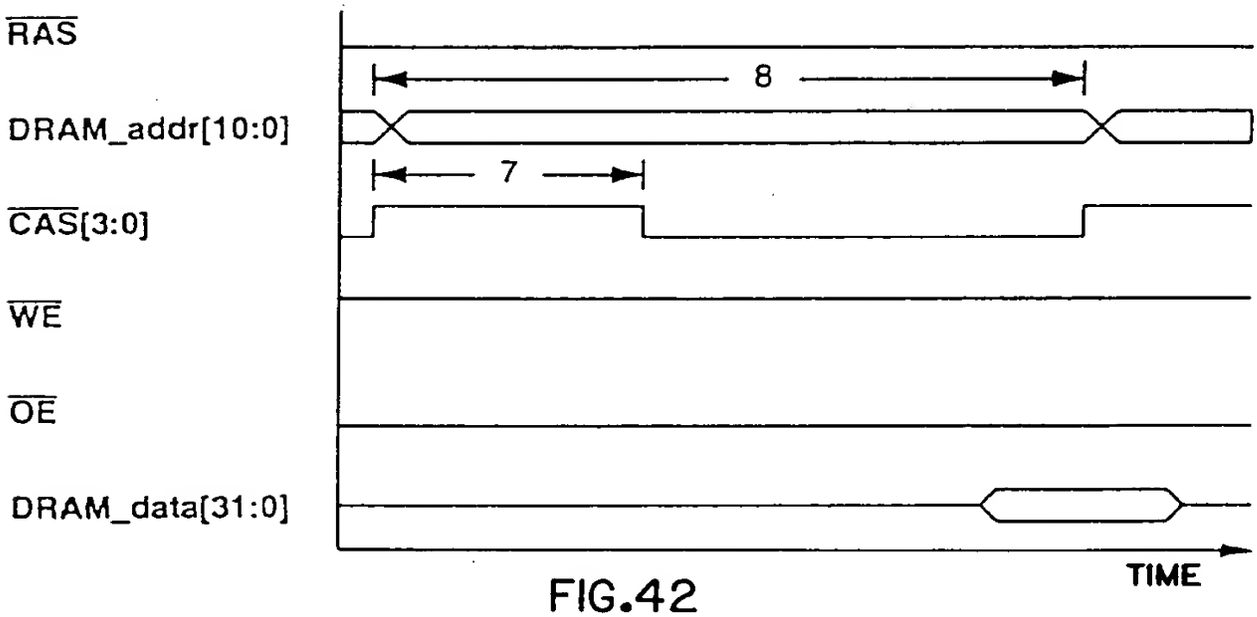

RAS
DRAM_addr[10:0]
CAS[3:0]
WE
OE
DRAM_data[31:0]
8
7
TIME

FIG.42

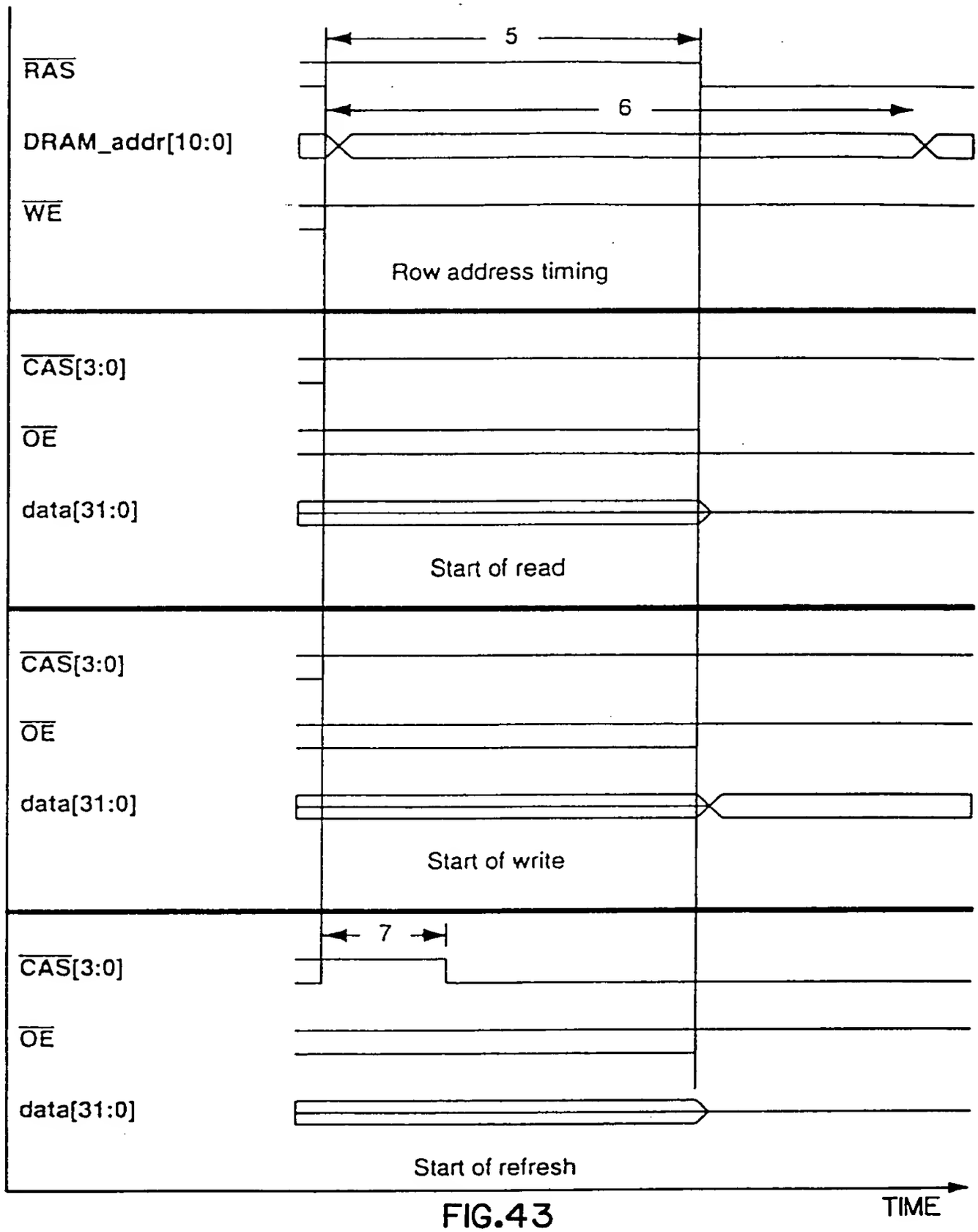

5
6
RAS
DRAM_addr[10:0]
WE
Row address timing
CAS[3:0]
OE
data[31:0]
Start of read
CAS[3:0]
OE
data[31:0]
Start of write
7
CAS[3:0]
OE
data[31:0]
Start of refresh
TIME

FIG.43

EP 0 720 020 A2

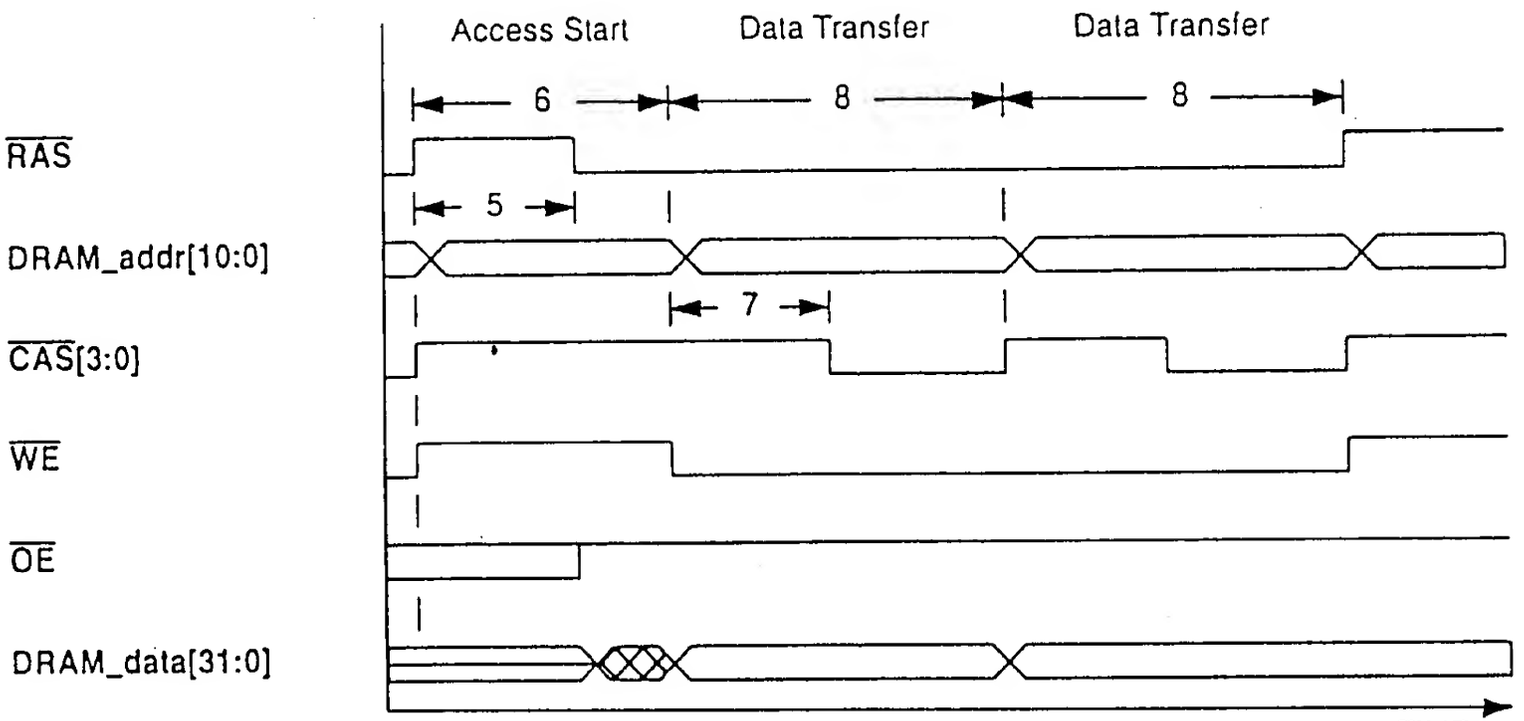


FIG.44

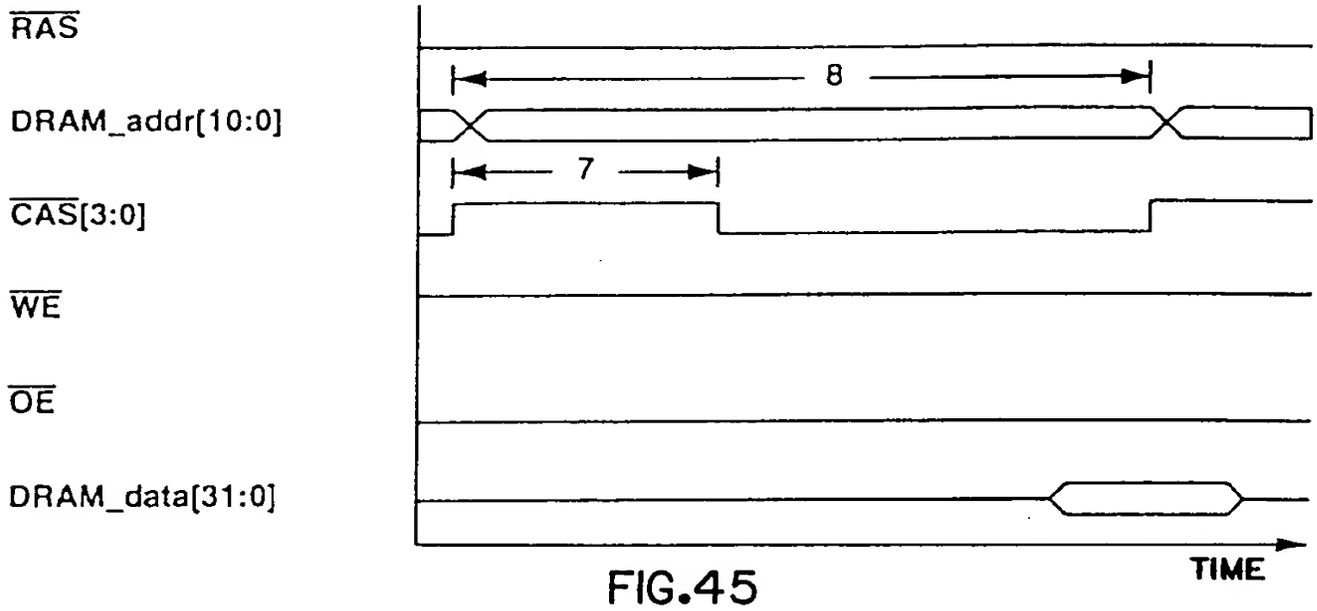

RAS
DRAM_addr[10:0]
CAS[3:0]
WE
OE
DRAM_data[31:0]
8
7
TIME

FIG.45

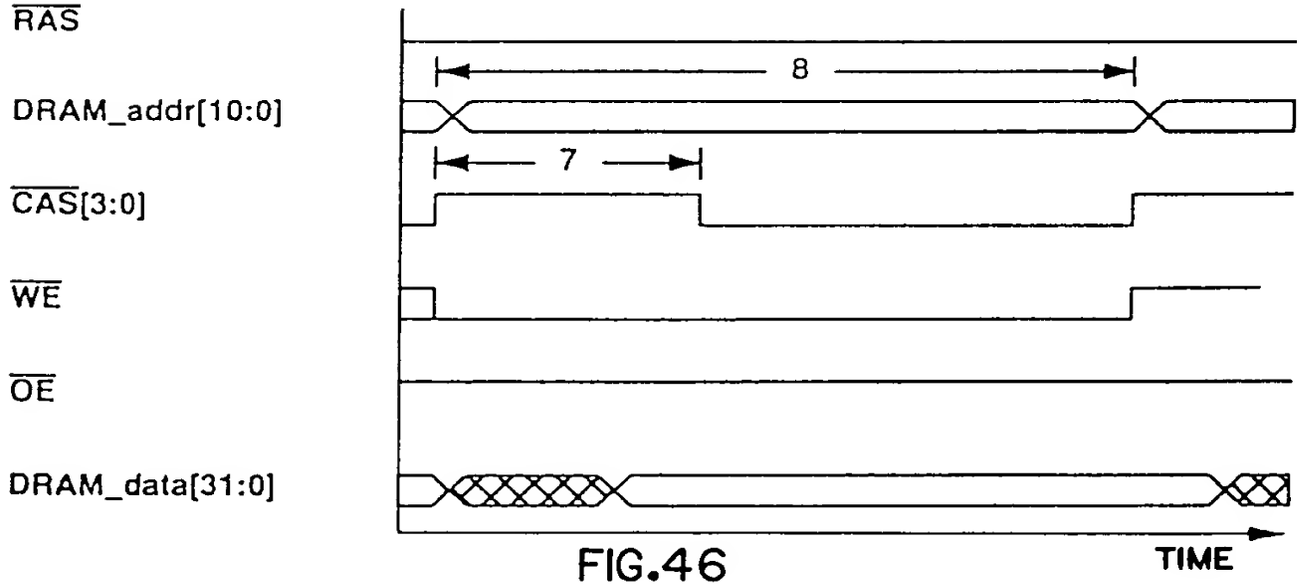

RAS
DRAM_addr[10:0]
CAS[3:0]
WE
OE
DRAM_data[31:0]
8
7
TIME

FIG.46

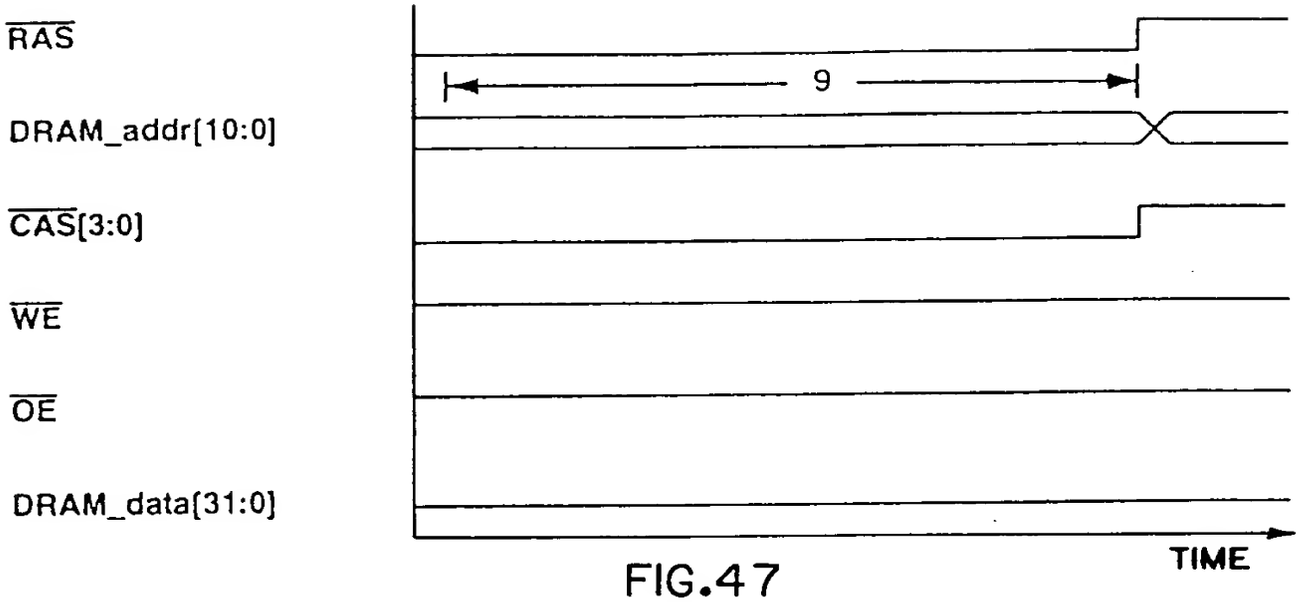

RAS
DRAM_addr[10:0]
CAS[3:0]
WE
OE
DRAM_data[31:0]
9
TIME

FIG.47

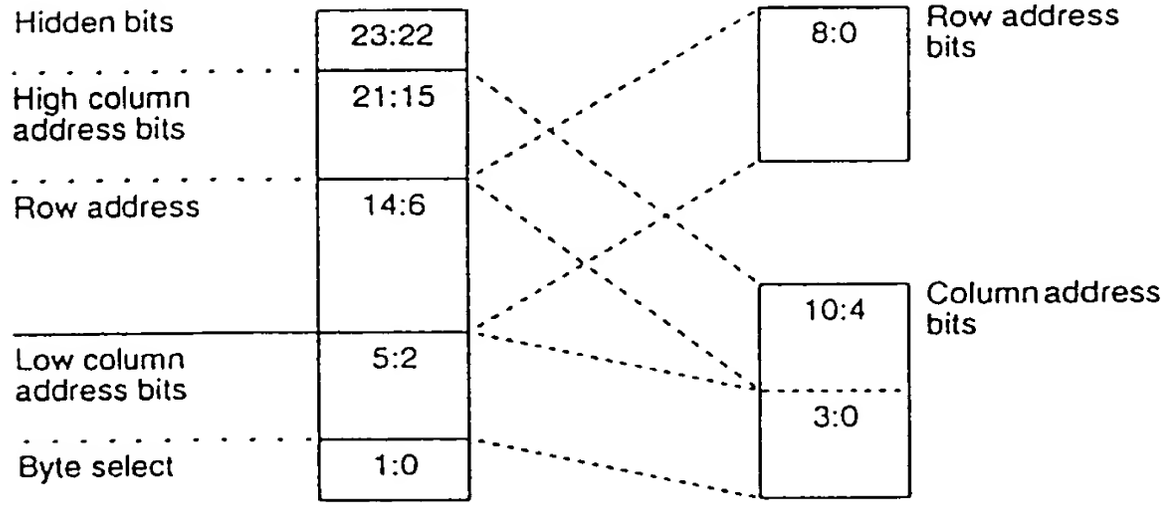

Hidden bits
High column address bits
Row address
Low column address bits
Byte select
23:22
21:15
14:6
5:2
1:0
8:0
Row address bits
10:4
3:0
Column address bits

FIG.48

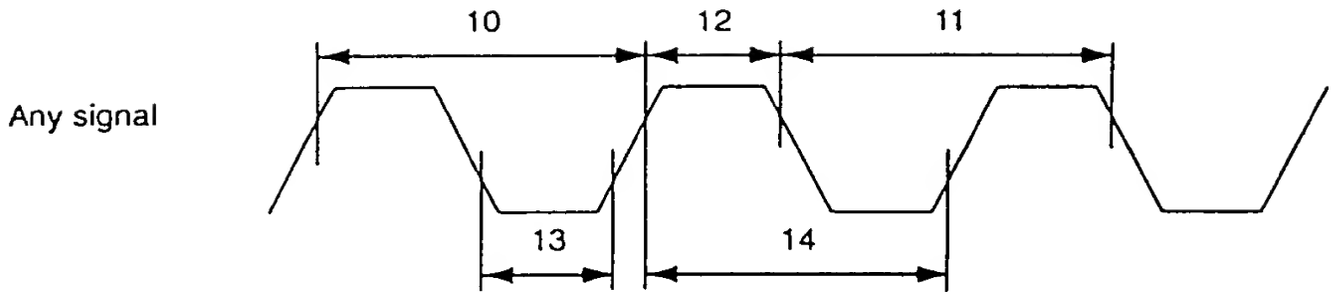

10
12
11
Any signal
13
14

FIG.49

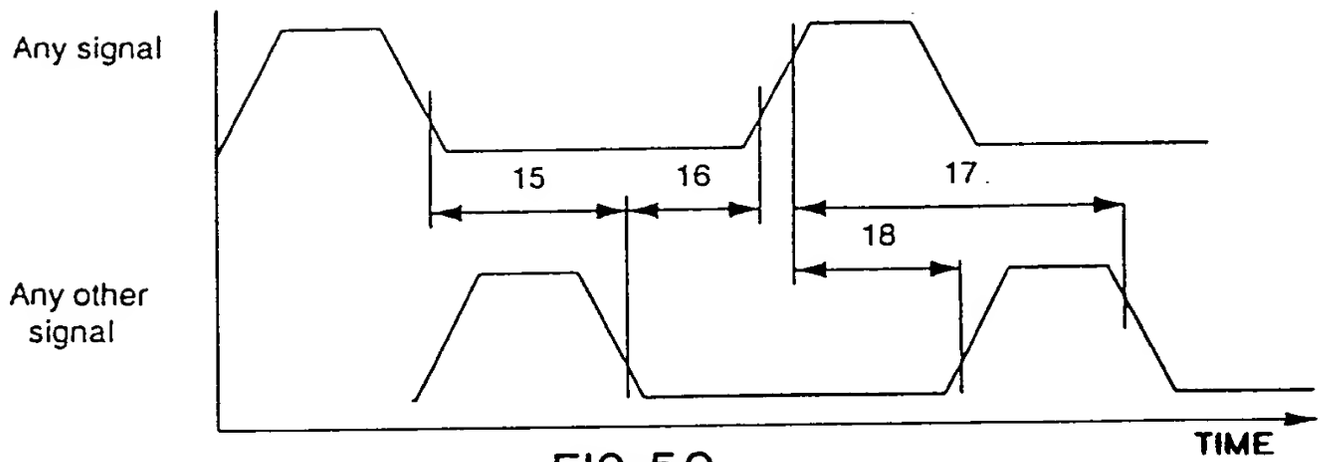

Any signal
15
16
17
18
Any other signal
TIME

FIG.50

FOR 0000 : 2/12/2000

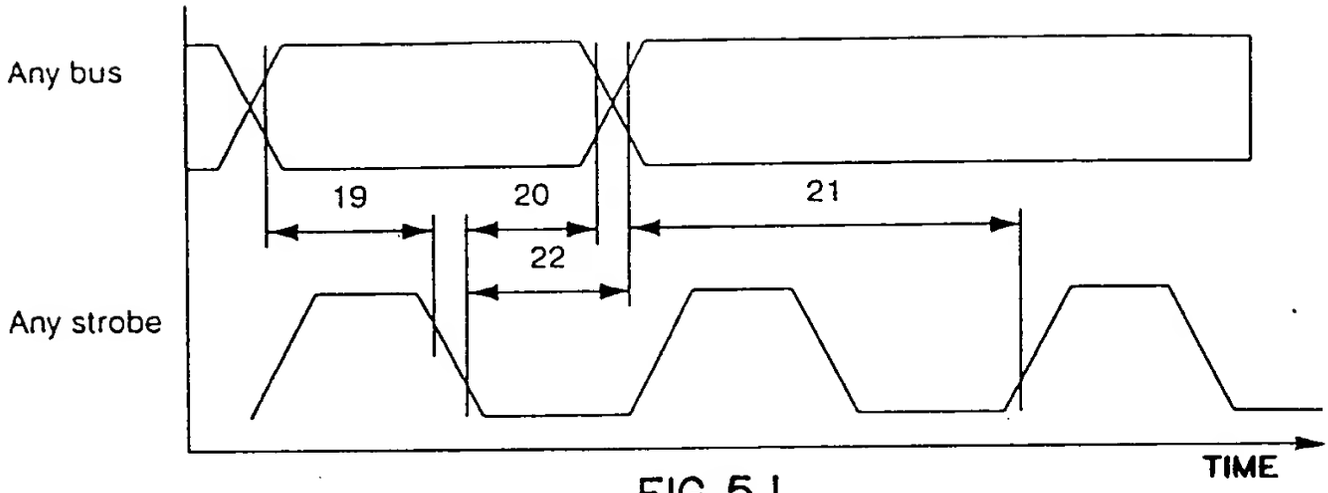


FIG.51

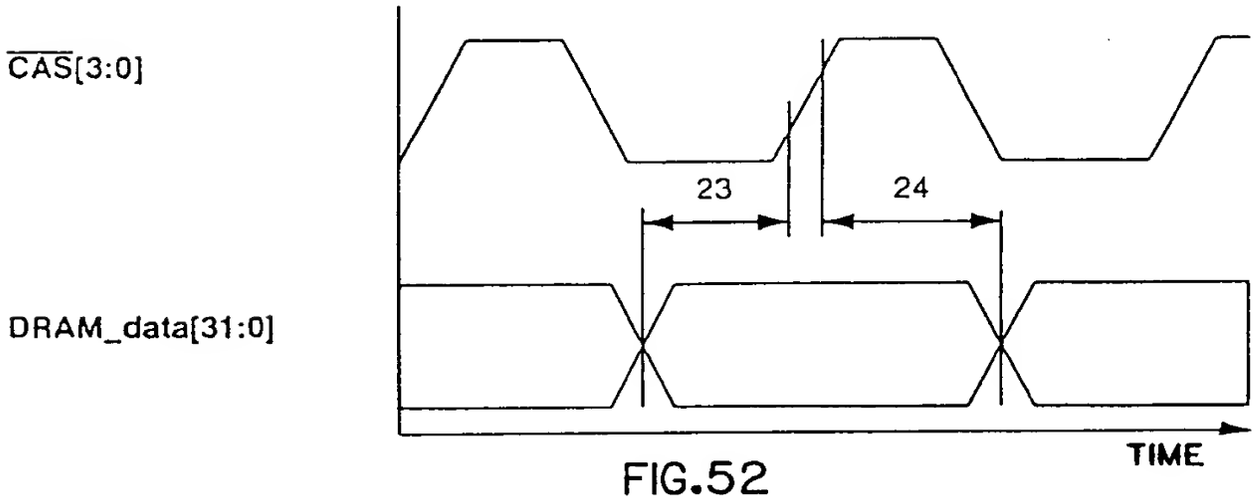


FIG.52

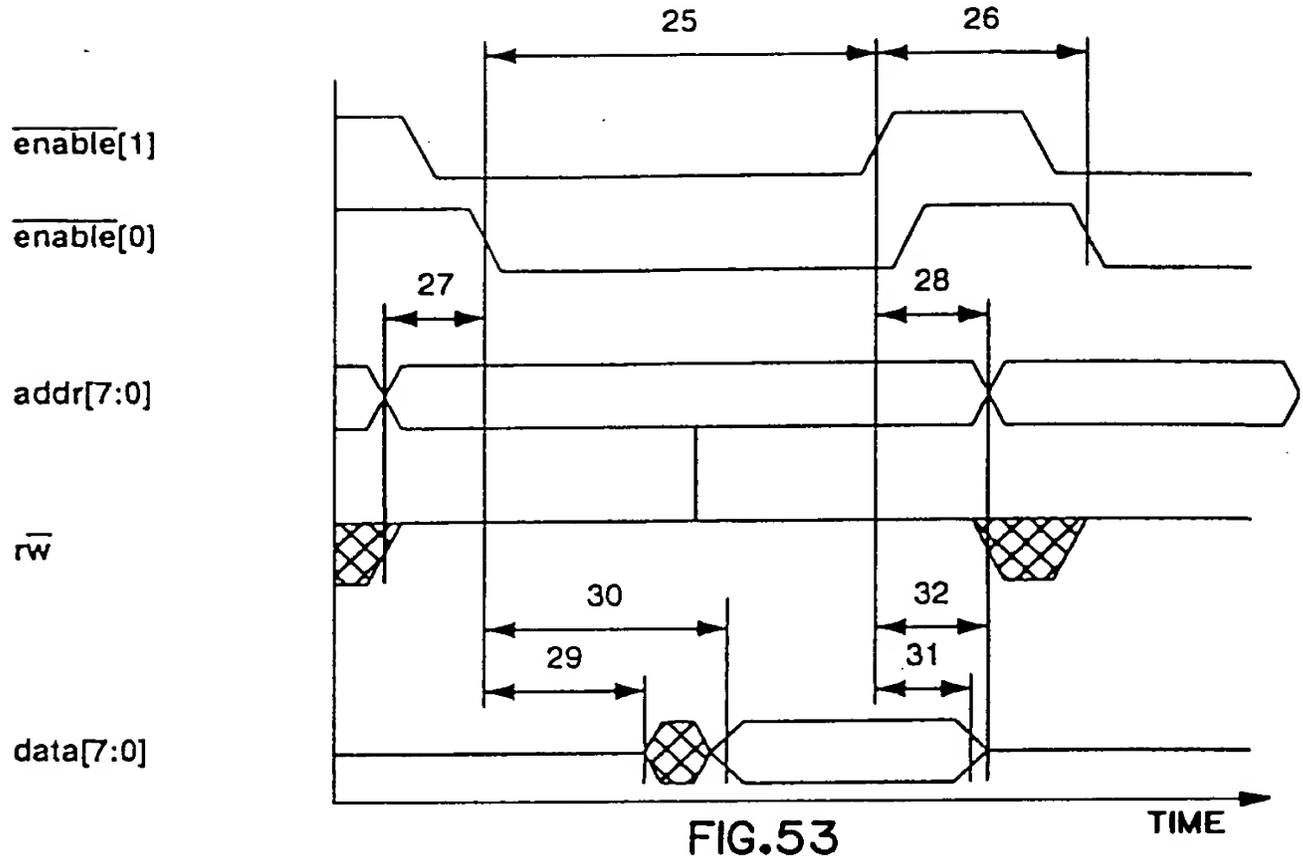

25
26
enable[1]
enable[0]
27
28
addr[7:0]
rw
30
32
29
31
data[7:0]
TIME

FIG.53

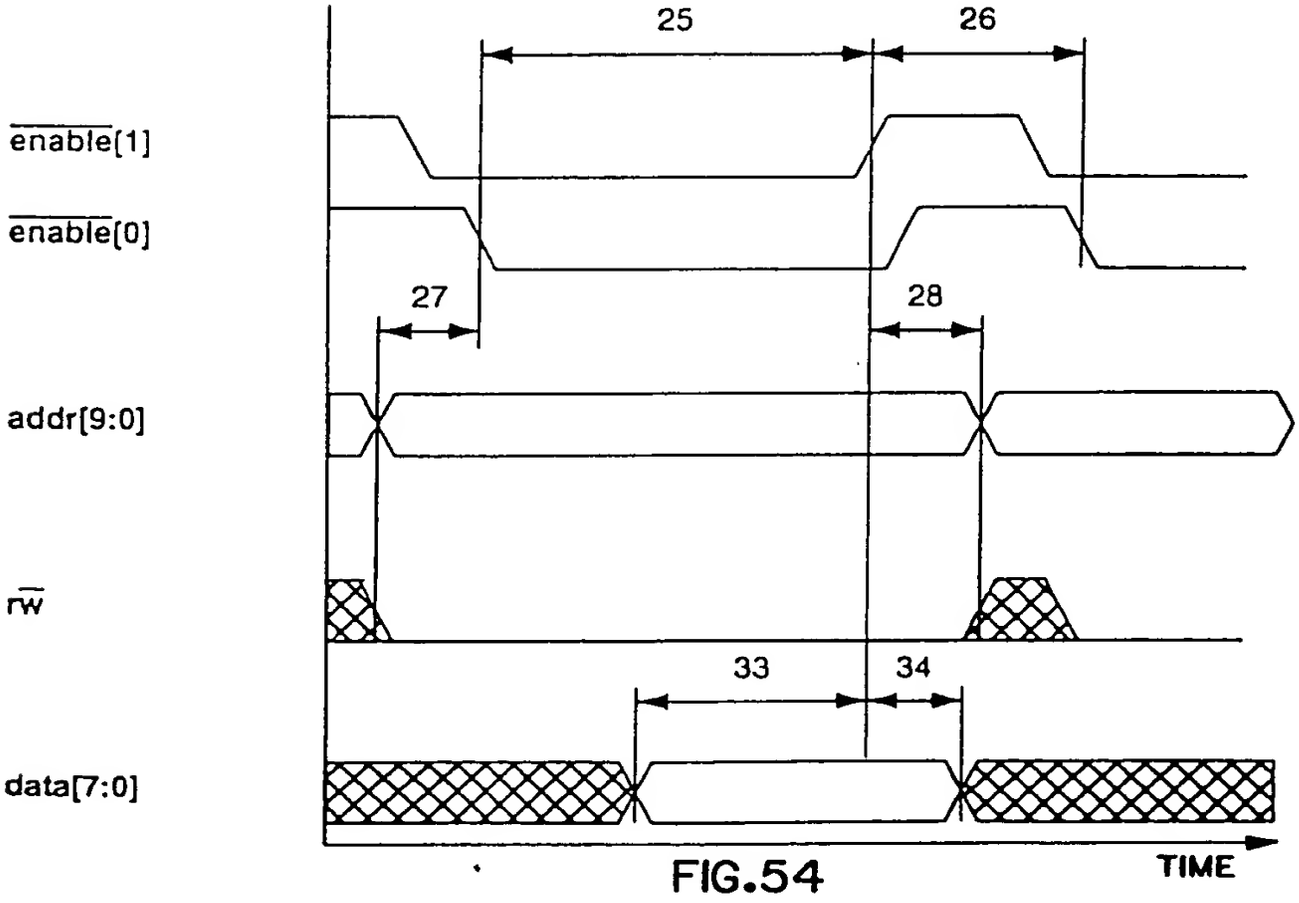

25
26
enable[1]
enable[0]
27
28
addr[9:0]
rw
33
34
data[7:0]
TIME

FIG.54

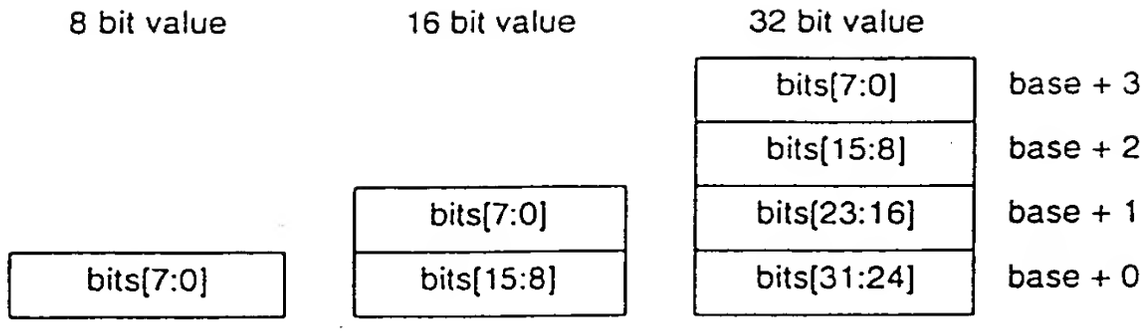

8 bit value
16 bit value
32 bit value
bits[7:0]
bits[7:0]
bits[15:8]
bits[7:0]
bits[15:8]
bits[23:16]
bits[31:24]
base + 3
base + 2
base + 1
base + 0

FIG.55

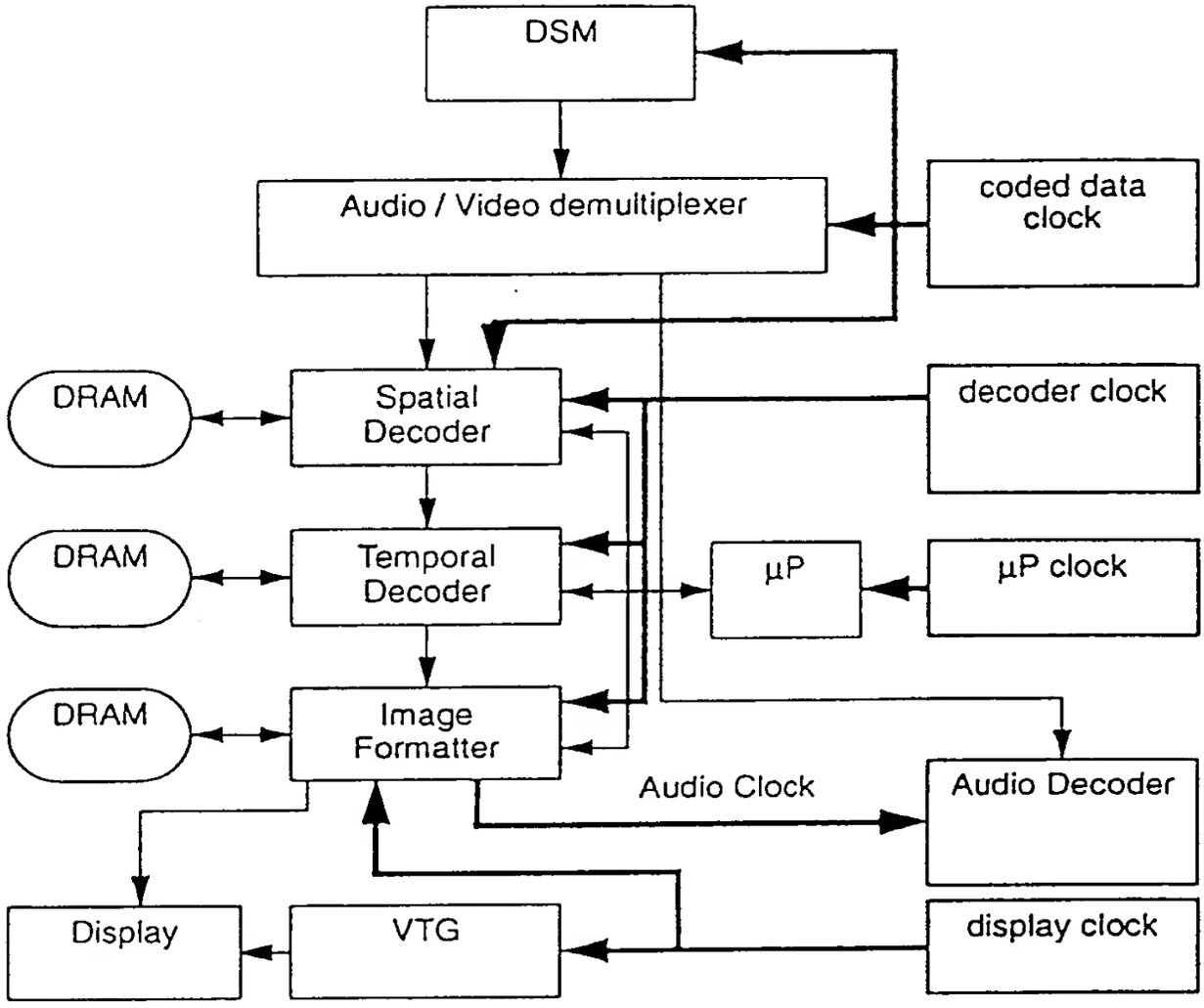

DSM
Audio / Video demultiplexer
coded data clock
DRAM
Spatial Decoder
decoder clock
DRAM
Temporal Decoder
µP
µP clock
DRAM
Image Formatter
Audio Clock
Audio Decoder
Display
VTG
display clock

FIG.56

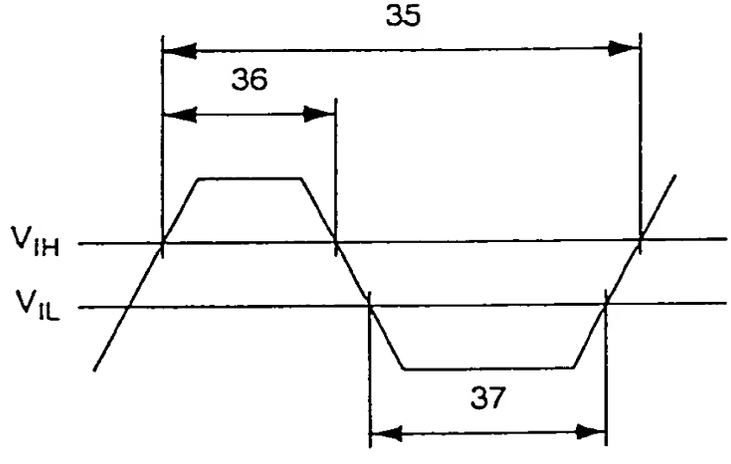

35
36
V_{IH}
V_{IL}
37

FIG.57

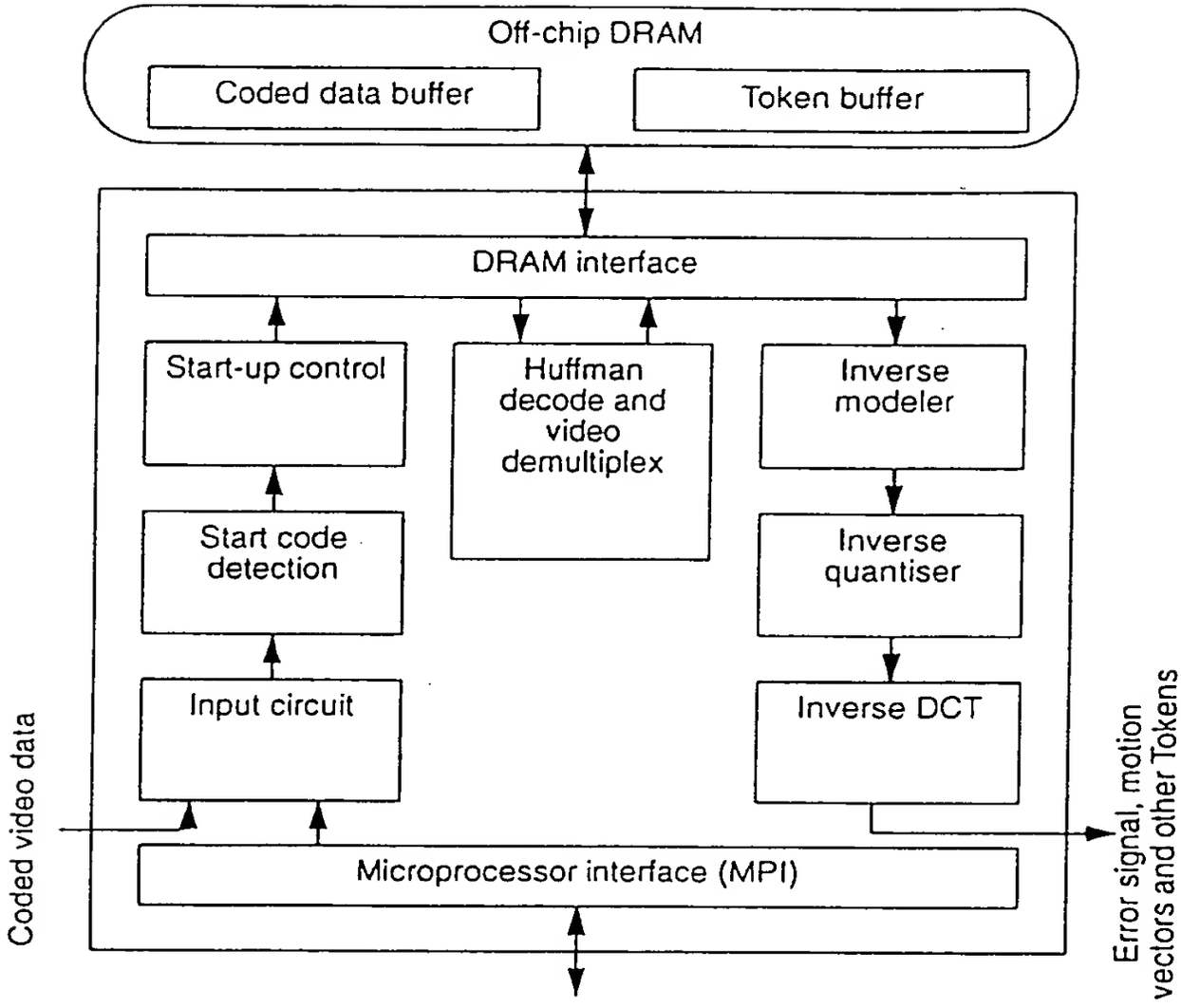

Off-chip DRAM
Coded data buffer
Token buffer
DRAM interface
Start-up control
Huffman decode and video demultiplex
Inverse modeler
Start code detection
Inverse quantiser
Input circuit
Inverse DCT
Coded video data
Microprocessor interface (MPI)
Error signal, motion vectors and other Tokens

FIG.58

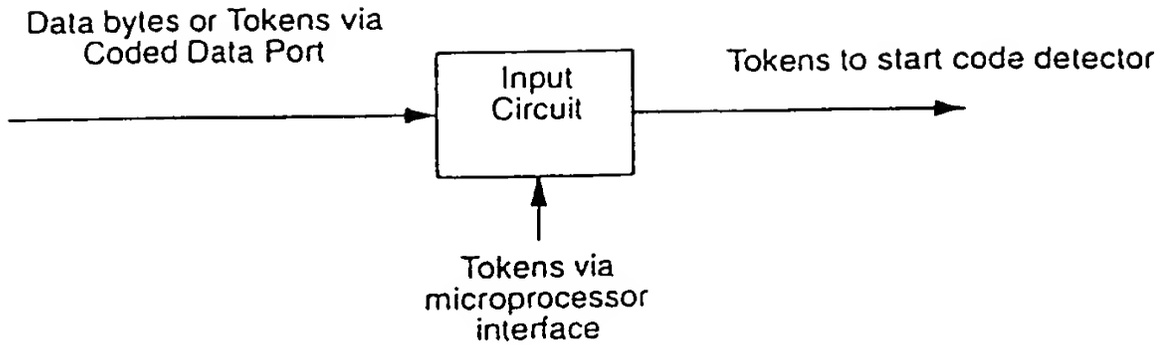

Data bytes or Tokens via
Coded Data Port
Input
Circuit
Tokens to start code detector
Tokens via
microprocessor
interface

FIG.59

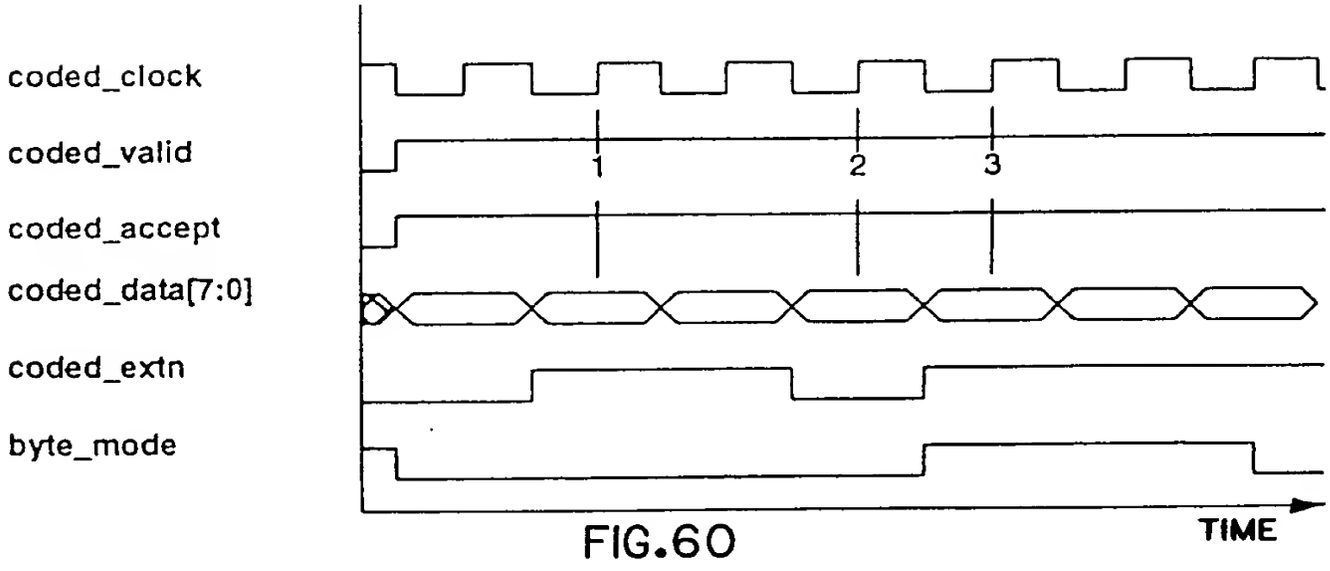

coded_clock
coded_valid
coded_accept
coded_data[7:0]
coded_extn
byte_mode
1
2
3
TIME

FIG.60

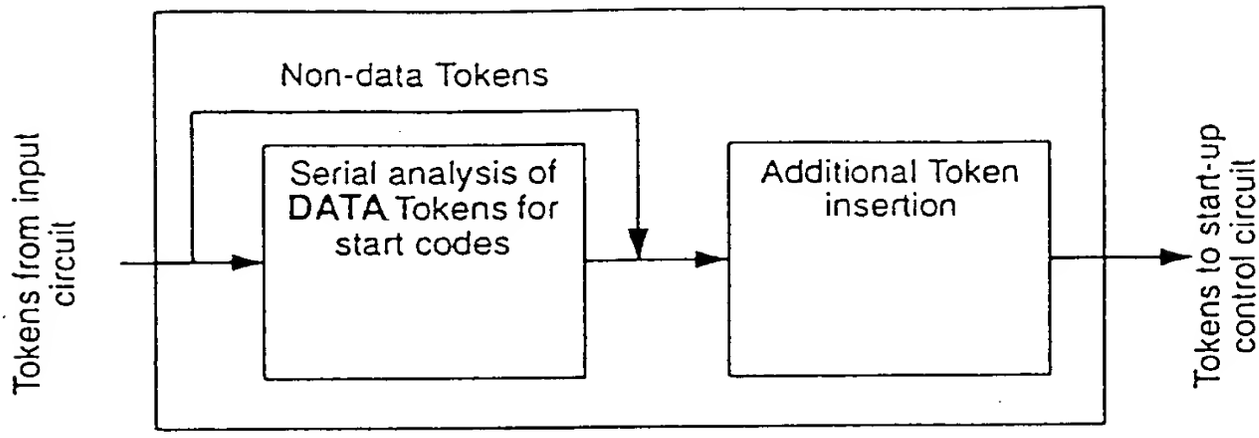

Non-data Tokens
Tokens from input circuit
Serial analysis of DATA Tokens for start codes
Additional Token insertion
Tokens to start-up control circuit

FIG.61

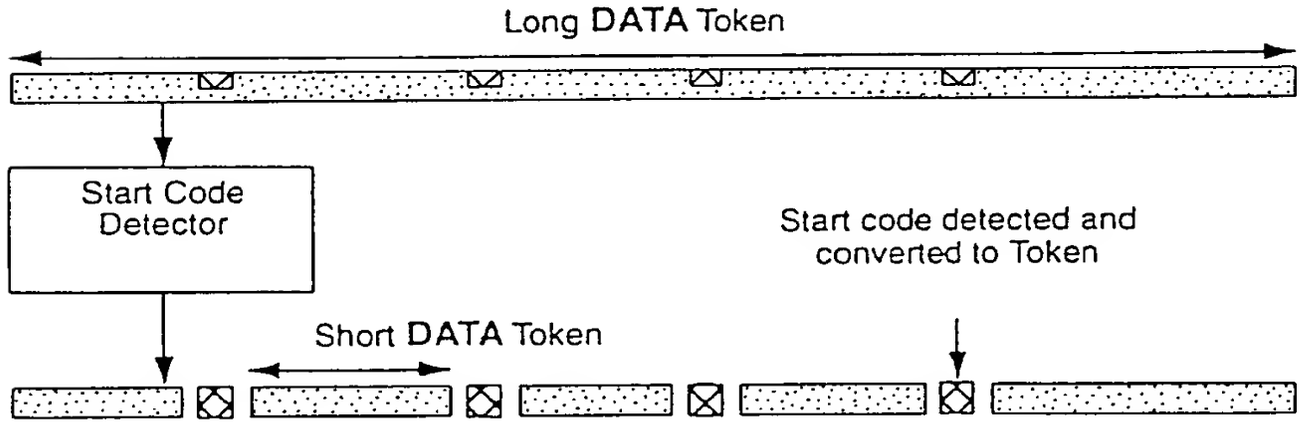

Long DATA Token
Start Code Detector
Start code detected and converted to Token
Short DATA Token

FIG.62

EP 0 560 420 A2

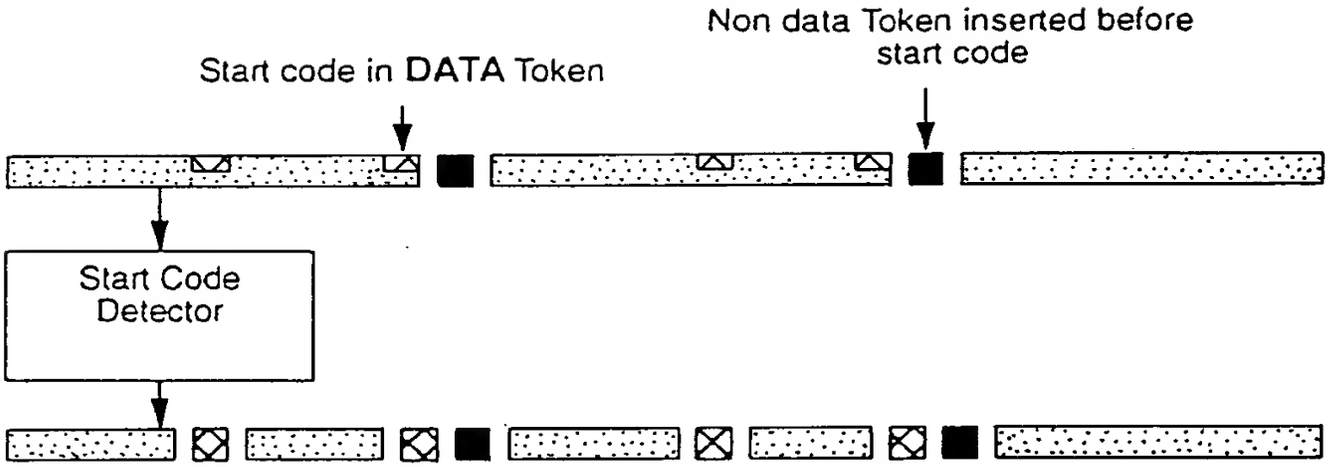


FIG.63

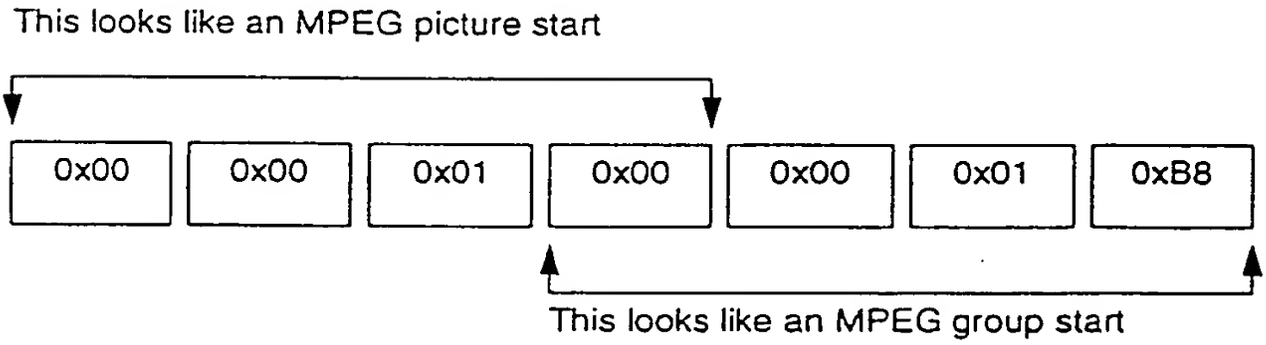


FIG.64

EP 0 720 380 A2

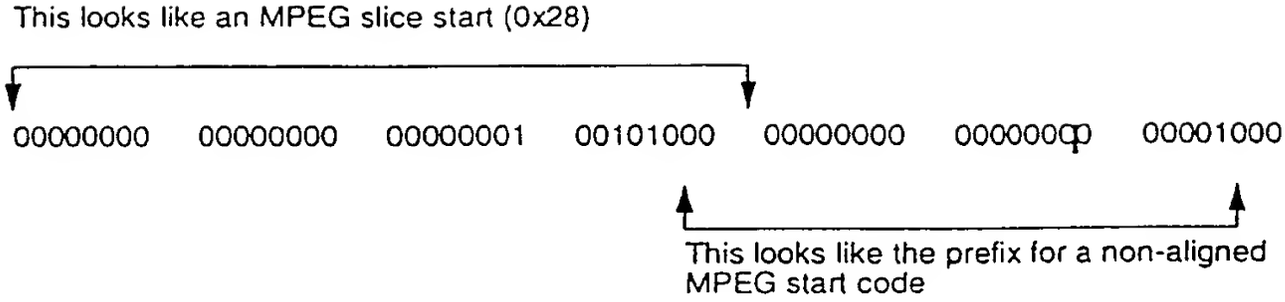


FIG.65

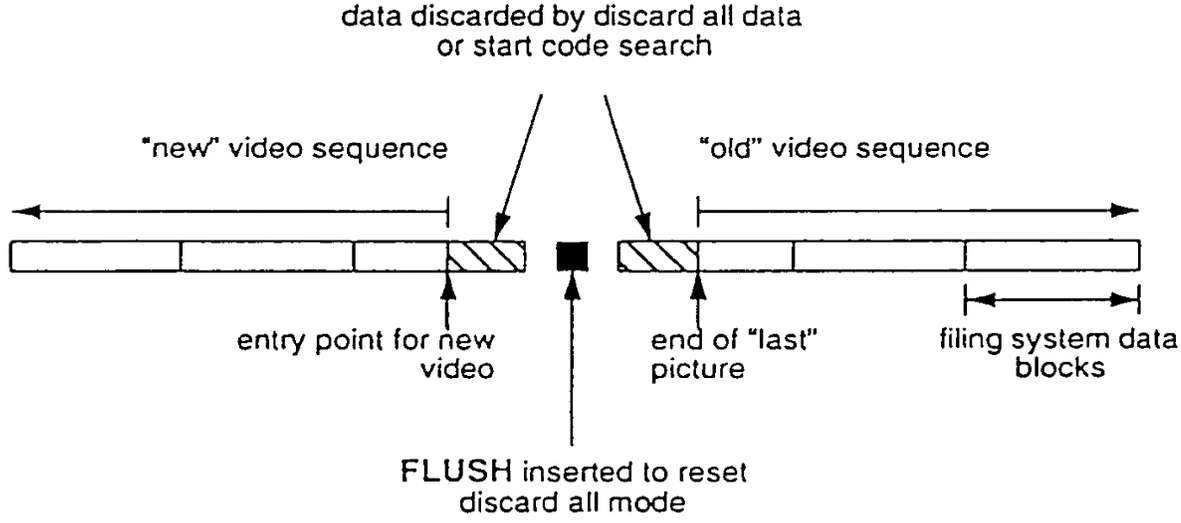


FIG.66

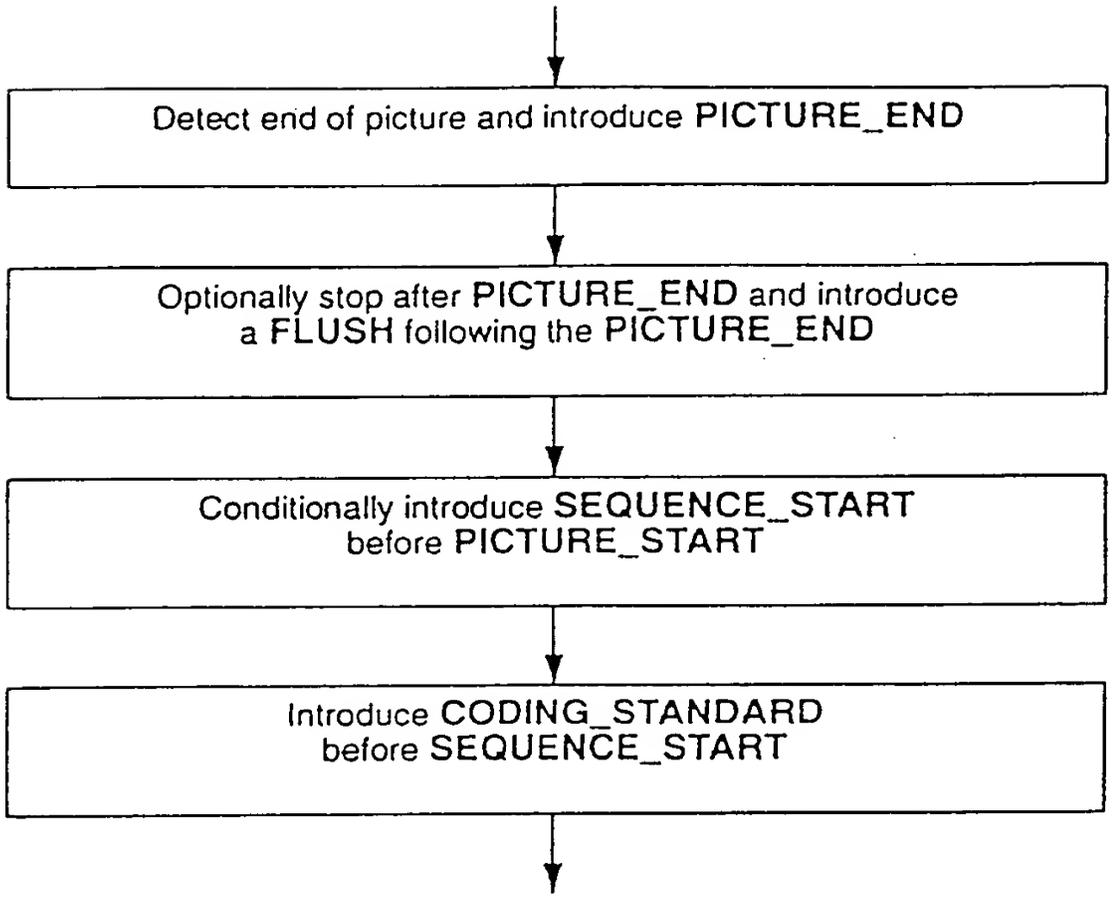

Detect end of picture and introduce PICTURE_END
Optionally stop after PICTURE_END and introduce a FLUSH following the PICTURE_END
Conditionally introduce SEQUENCE_START before PICTURE_START
Introduce CODING_STANDARD before SEQUENCE_START

FIG.67

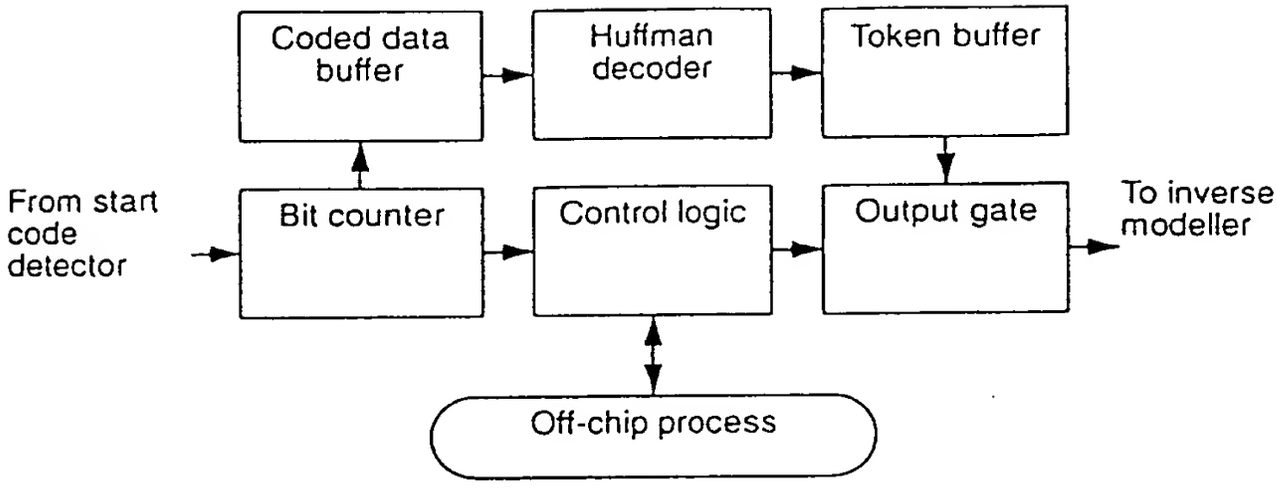

Coded data buffer
Huffman decoder
Token buffer
From start code detector
Bit counter
Control logic
Output gate
To inverse modeller
Off-chip process

FIG.68

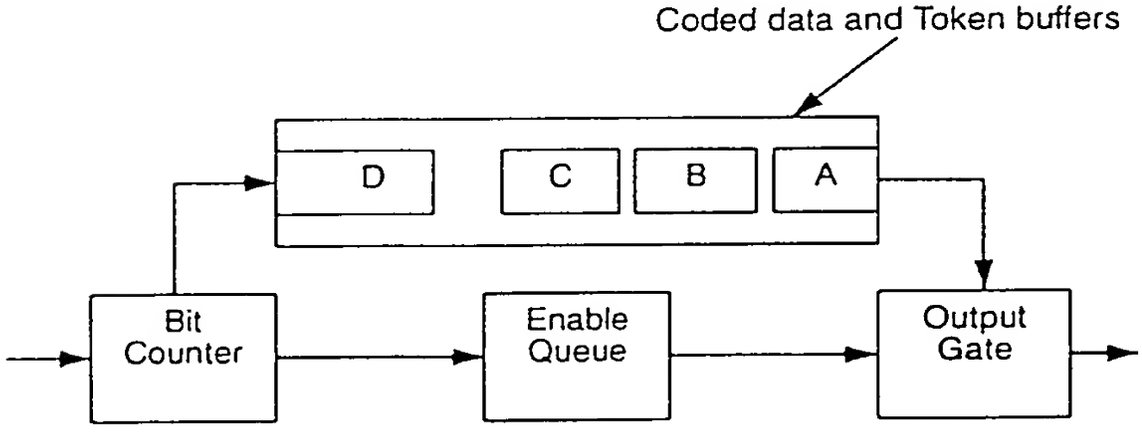

Coded data and Token buffers
D
C
B
A
Bit Counter
Enable Queue
Output Gate

FIG.69

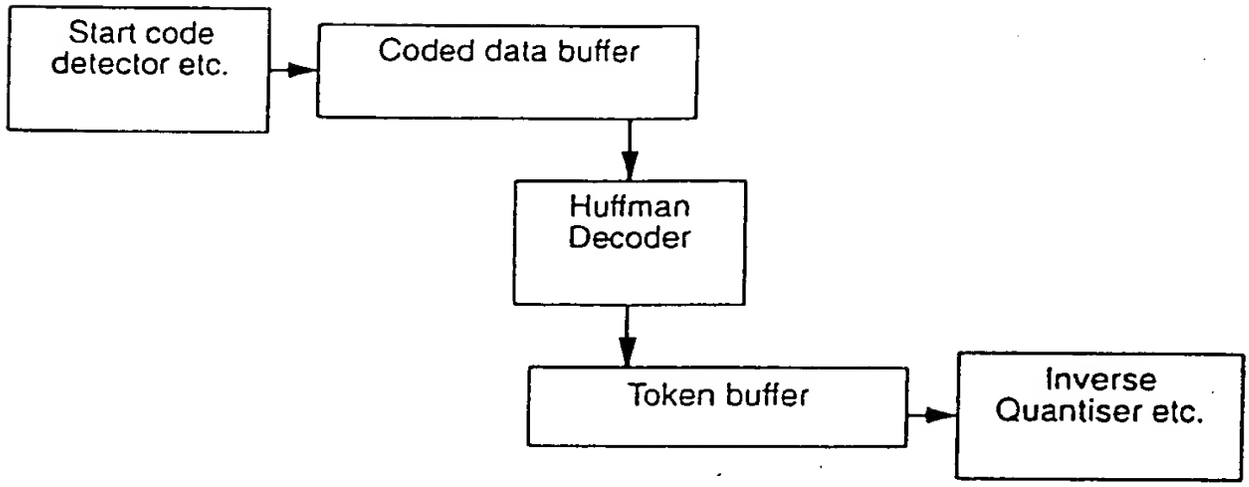

Start code detector etc.
Coded data buffer
Huffman Decoder
Token buffer
Inverse Quantiser etc.

FIG.70

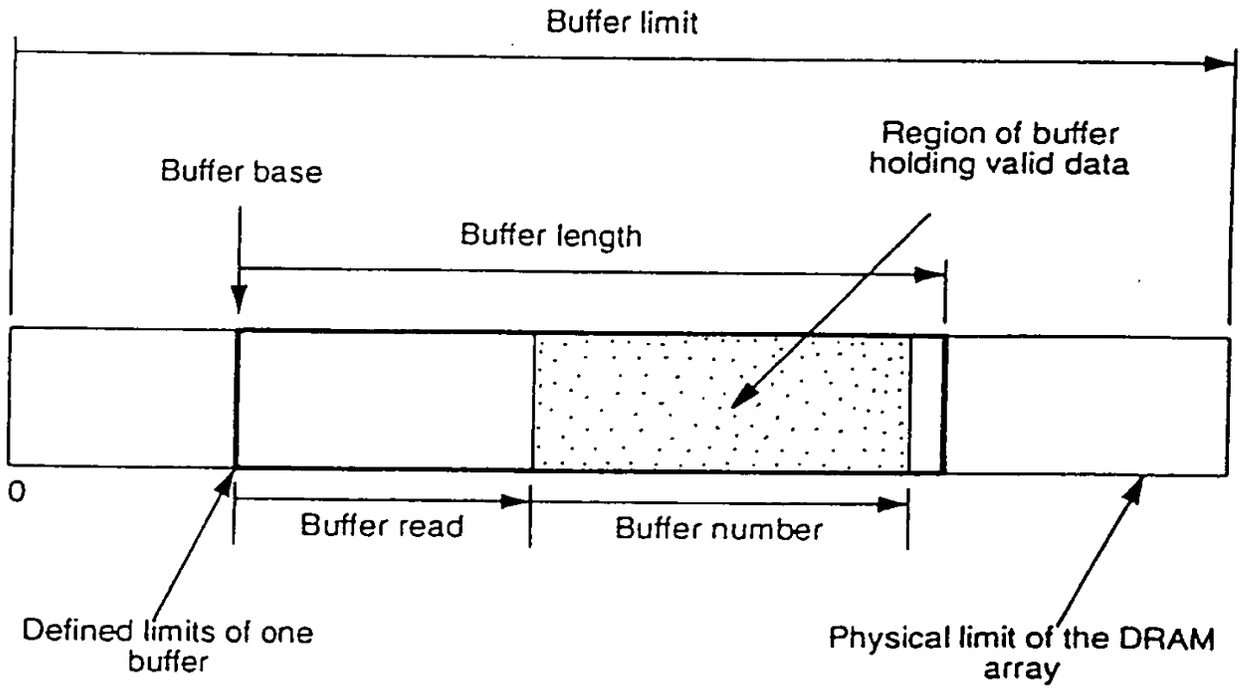

Buffer limit
Region of buffer holding valid data
Buffer base
Buffer length
0
Buffer read
Buffer number
Defined limits of one buffer
Physical limit of the DRAM array

FIG.71

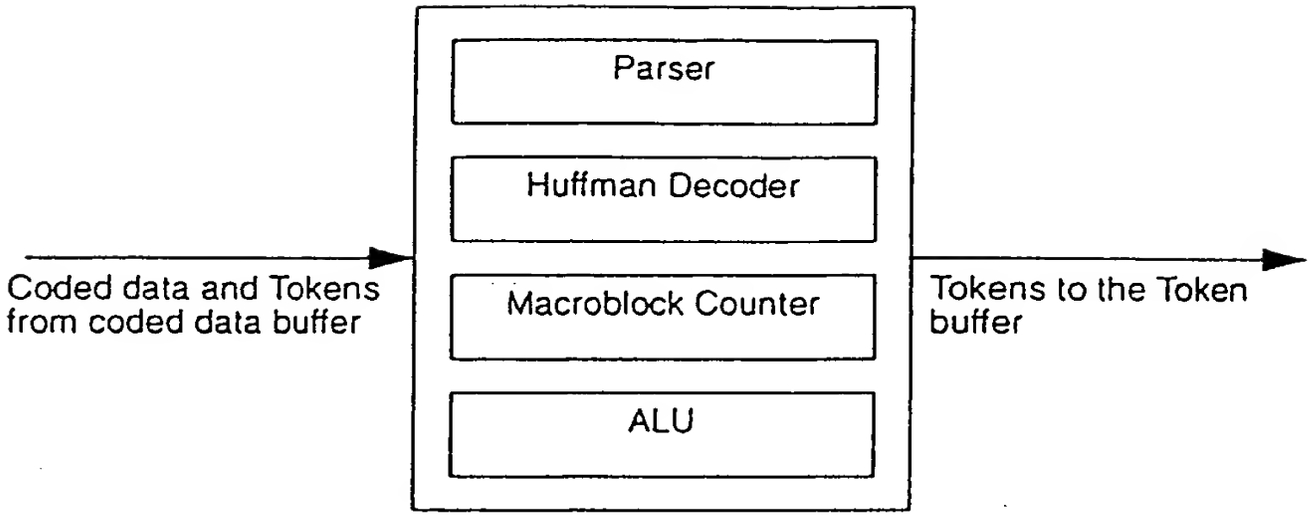

Parser
Huffman Decoder
Macroblock Counter
ALU
Coded data and Tokens from coded data buffer
Tokens to the Token buffer

FIG.72

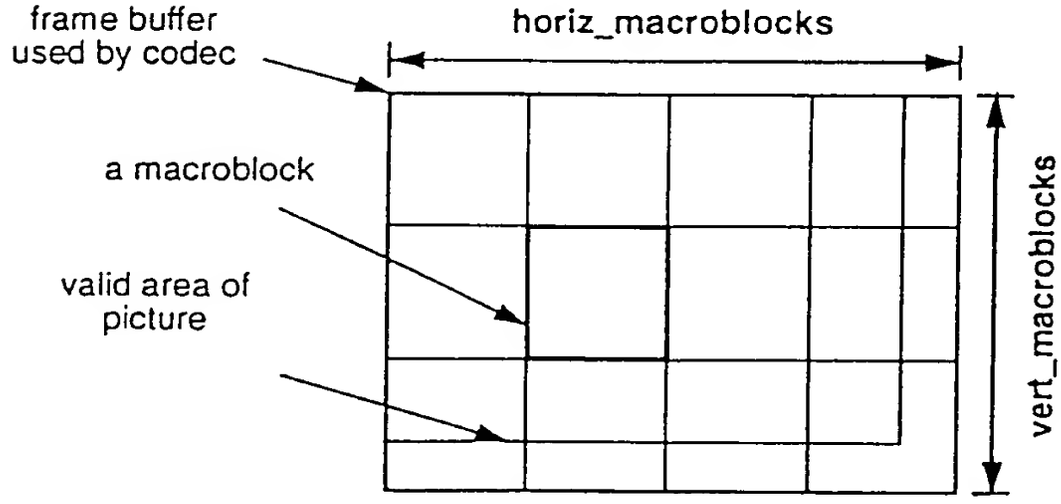

frame buffer used by codec
horiz_macroblocks
a macroblock
valid area of picture
vert_macroblocks

FIG.73

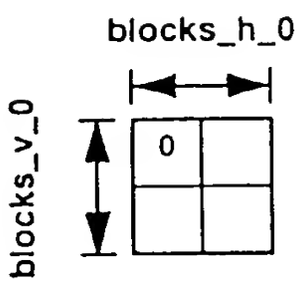


FIG.74A

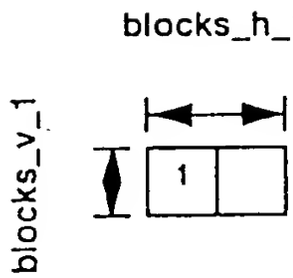


FIG.74B

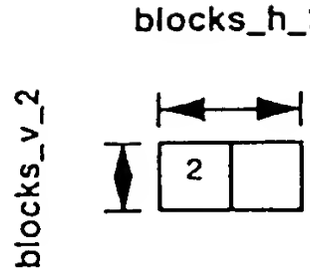


FIG.74C

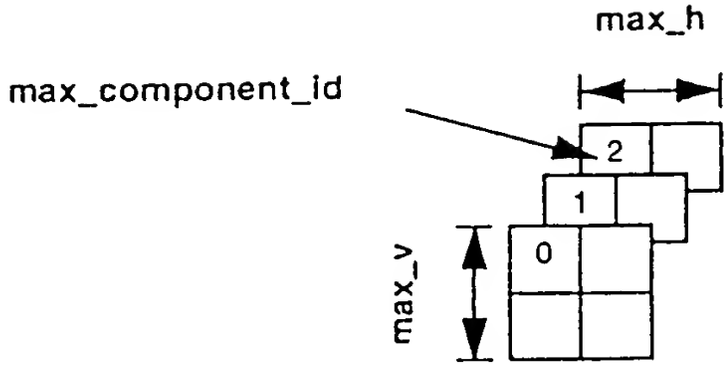


FIG.74D

$$\begin{cases} \text{horiz_macroblocks} = \dfrac{\text{horiz_pels} + 15}{16} \\ \text{vert_macroblocks} = \dfrac{\text{vert_pels} + 15}{16} \end{cases}$$

FIG.75

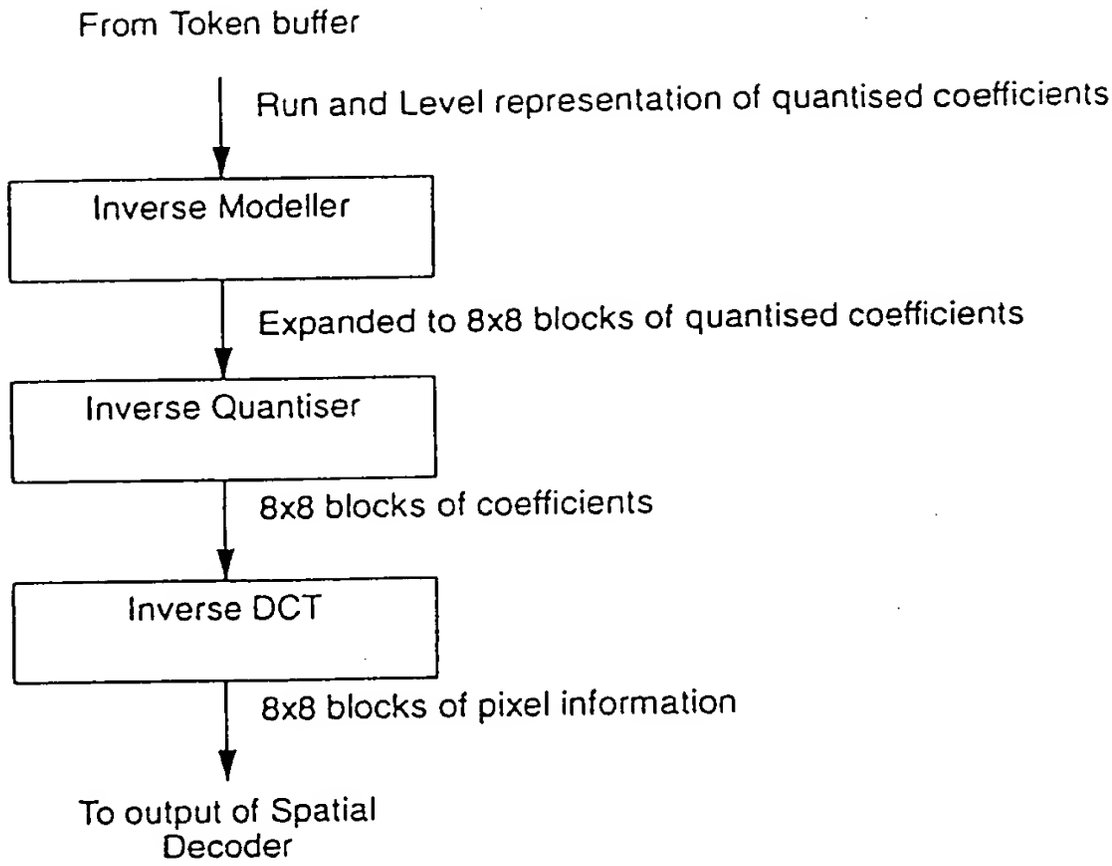

From Token buffer
Run and Level representation of quantised coefficients
Inverse Modeller
Expanded to 8x8 blocks of quantised coefficients
Inverse Quantiser
8x8 blocks of coefficients
Inverse DCT
8x8 blocks of pixel information
To output of Spatial Decoder

FIG.76

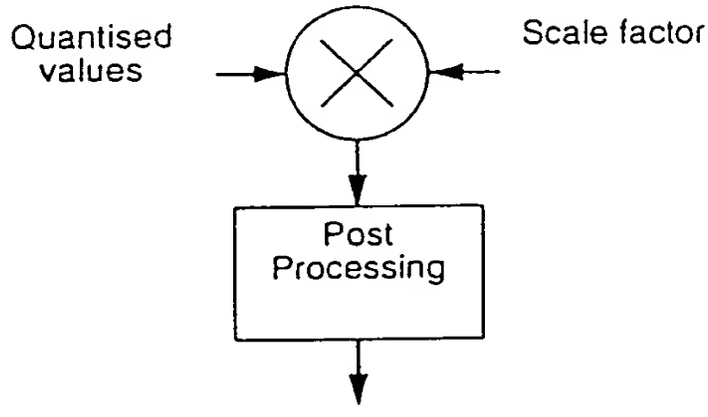

Quantised values
Scale factor
Post Processing

FIG.77

EP 0 574 260 A2

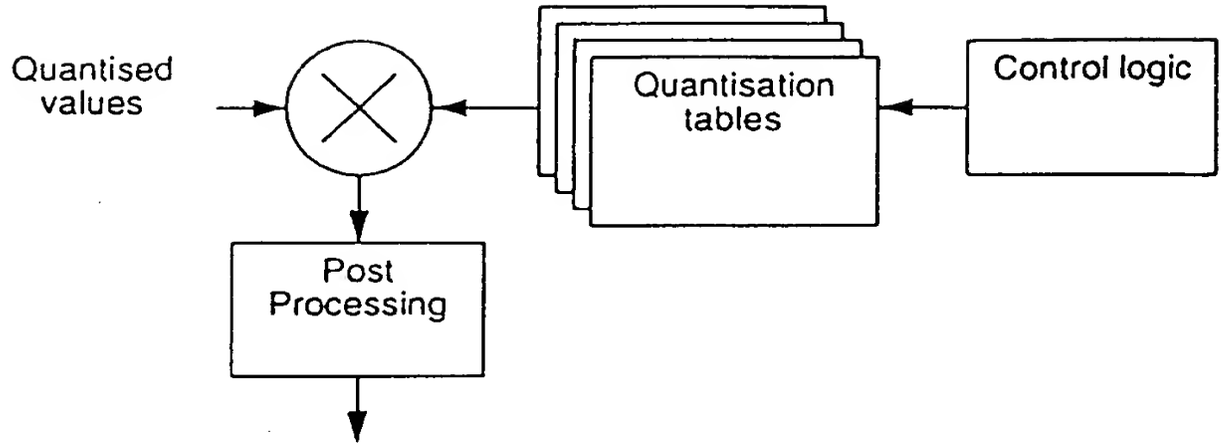


FIG.78

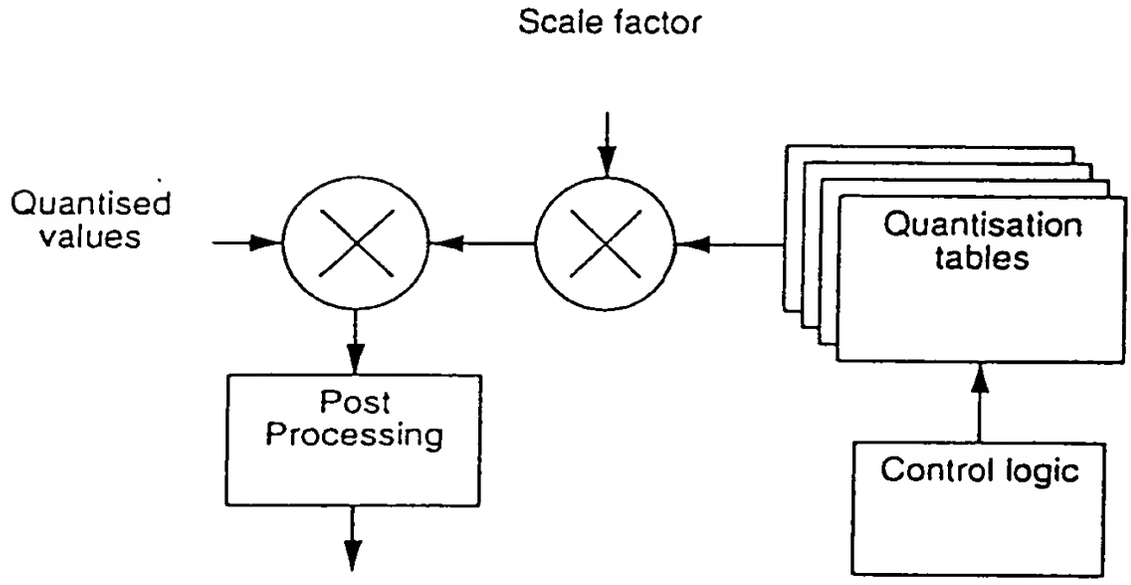


FIG.79

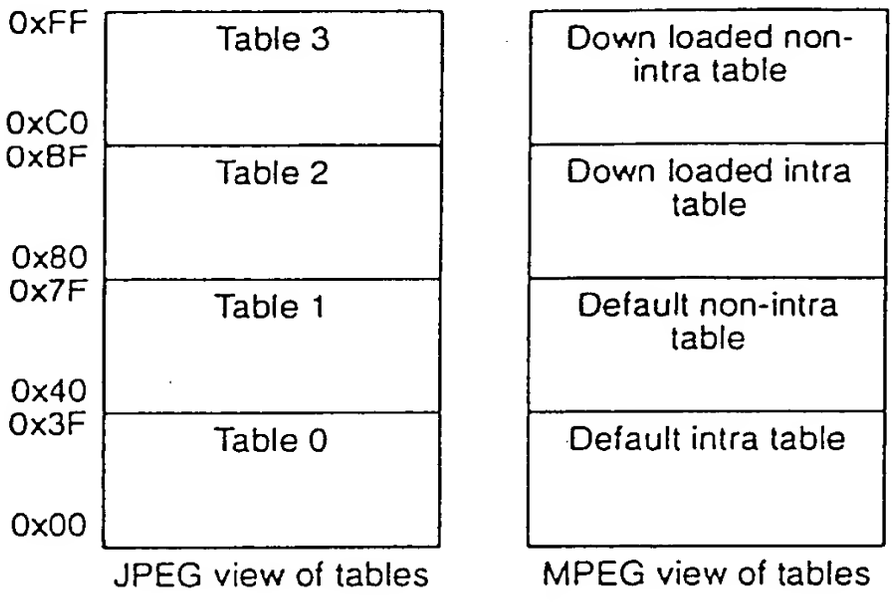


FIG.80

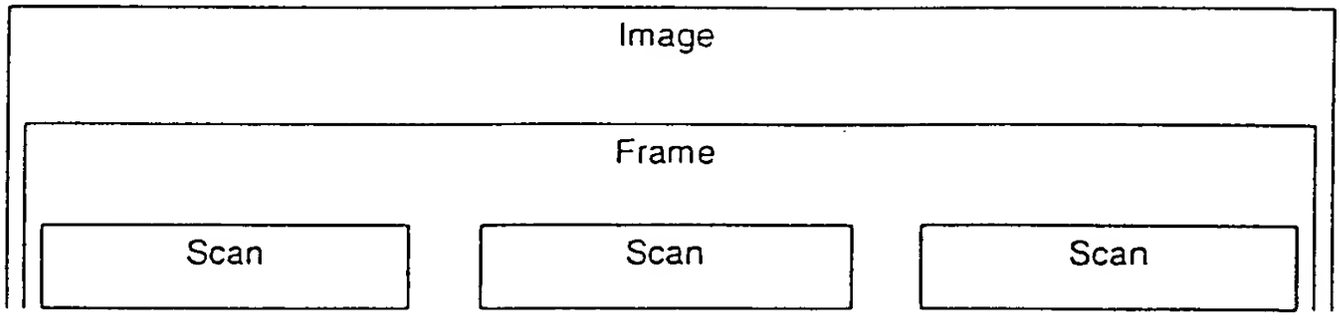


FIG.81

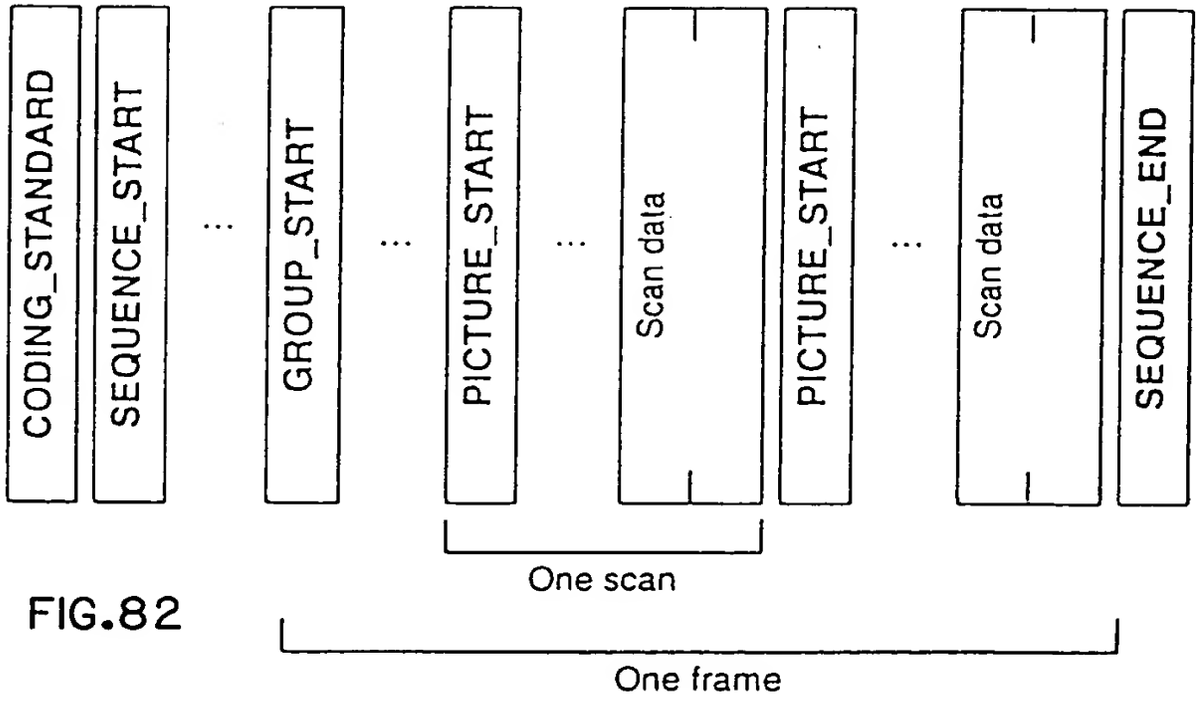


FIG.82

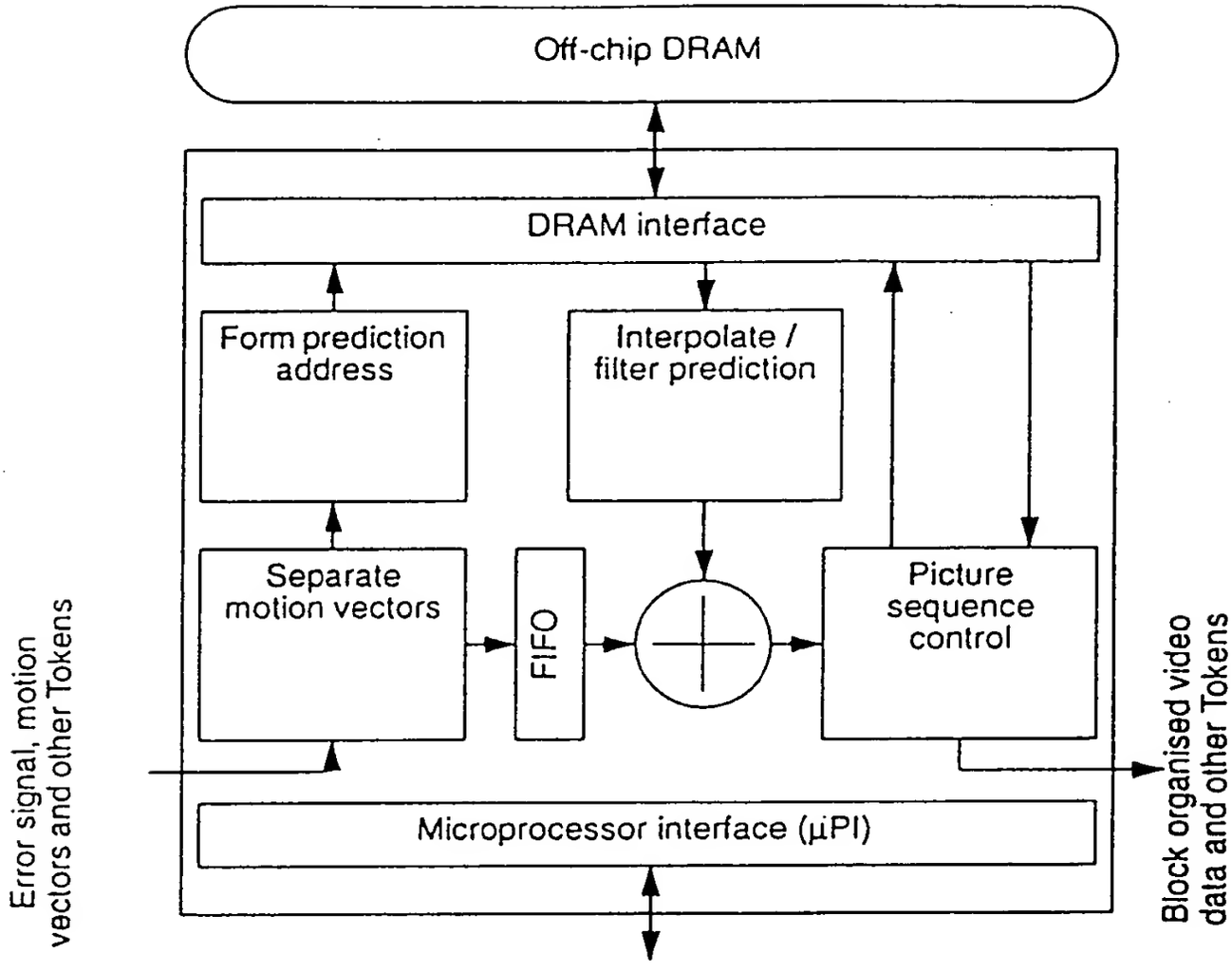

Off-chip DRAM
DRAM interface
Form prediction address
Interpolate / filter prediction
Separate motion vectors
FIFO
Picture sequence control
Microprocessor interface (µPI)
Error signal, motion vectors and other Tokens
Block organised video data and other Tokens

FIG.83

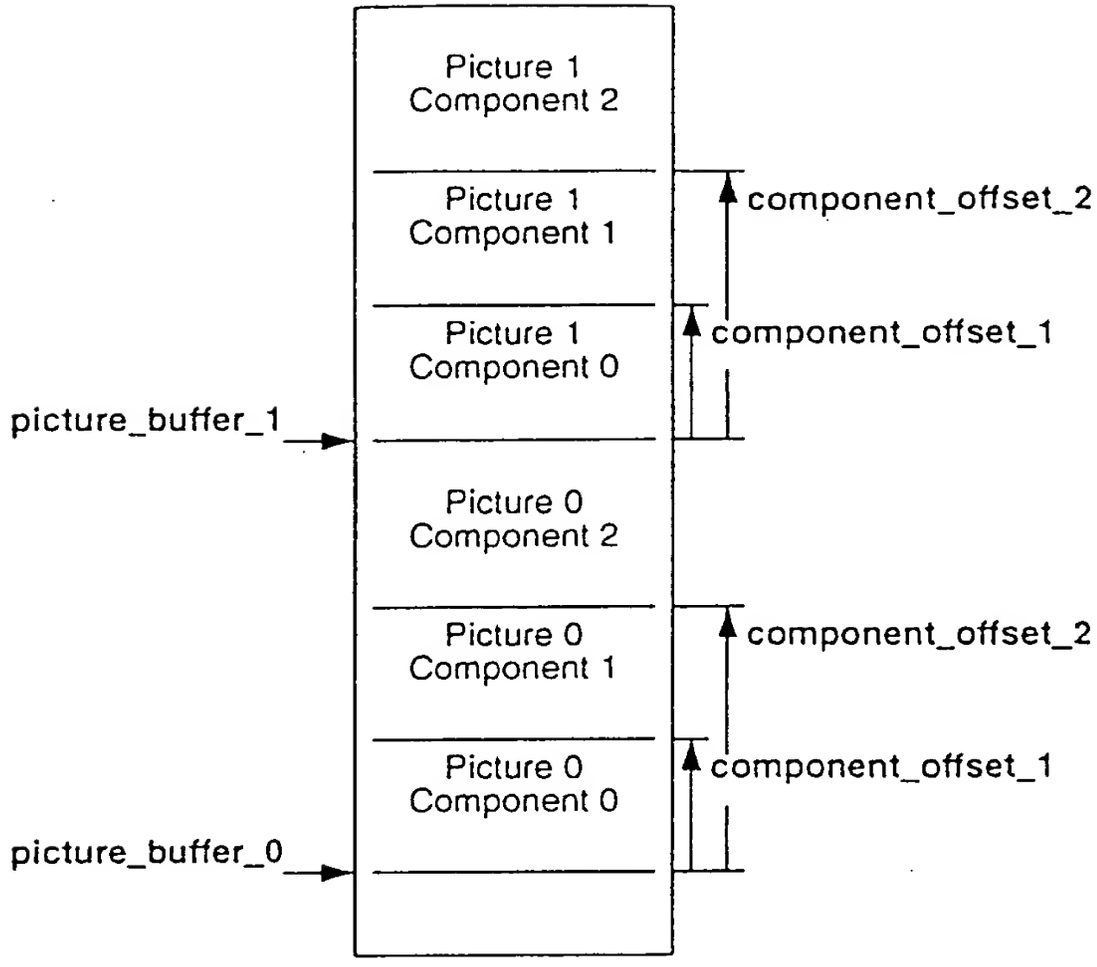

Picture 1
Component 2
Picture 1
Component 1
Picture 1
Component 0
Picture 0
Component 2
Picture 0
Component 1
Picture 0
Component 0
component_offset_2
component_offset_1
component_offset_2
component_offset_1
picture_buffer_1
picture_buffer_0

FIG.84

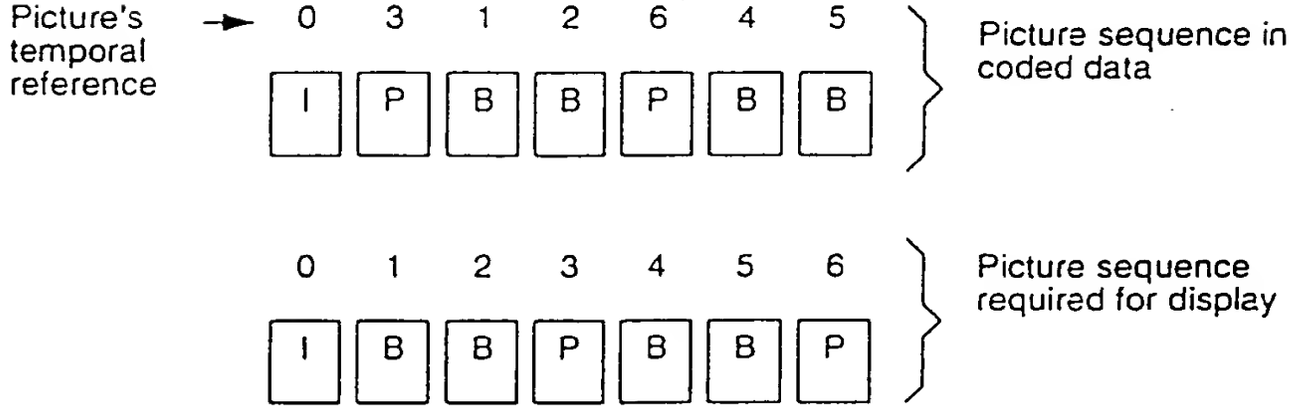

Picture's
temporal
reference
0 3 1 2 6 4 5
I P B B P B B
Picture sequence in
coded data
0 1 2 3 4 5 6
I B B P B B P
Picture sequence
required for display

FIG.85

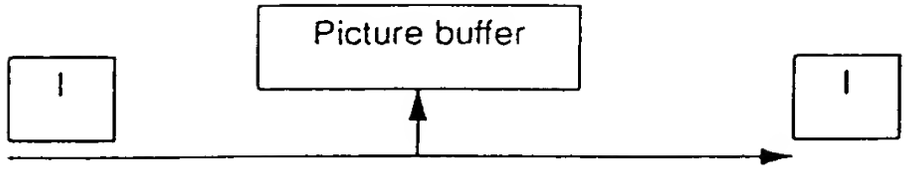


FIG.86

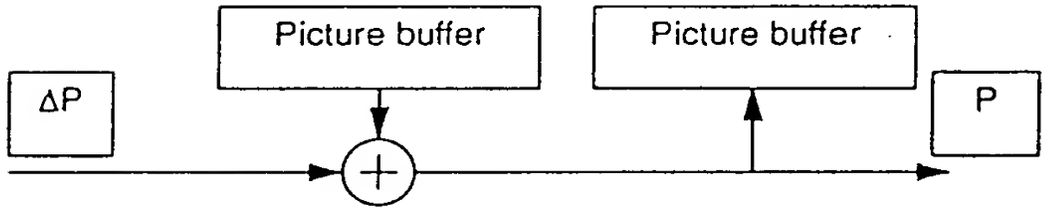


FIG.87

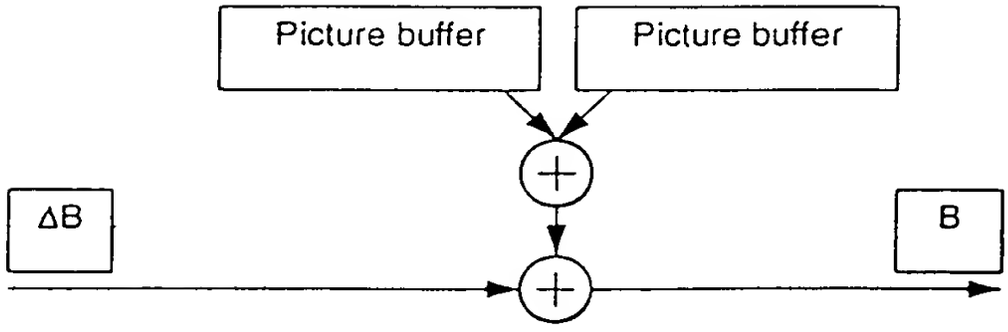


FIG.88

EP 0 618 726 A2

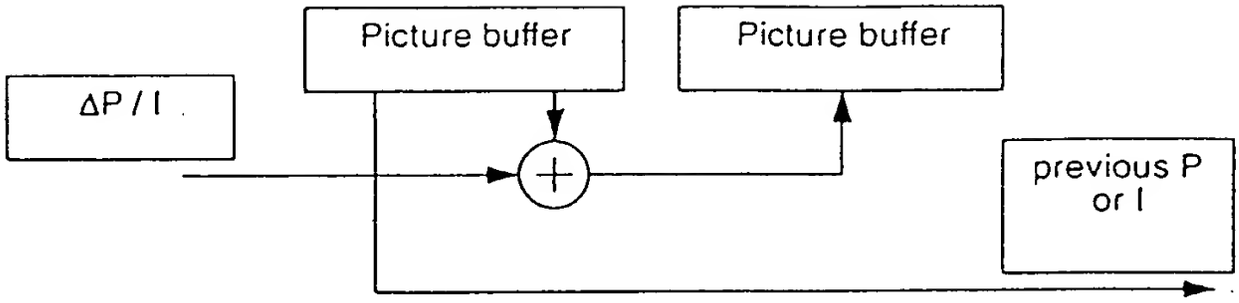


FIG.89

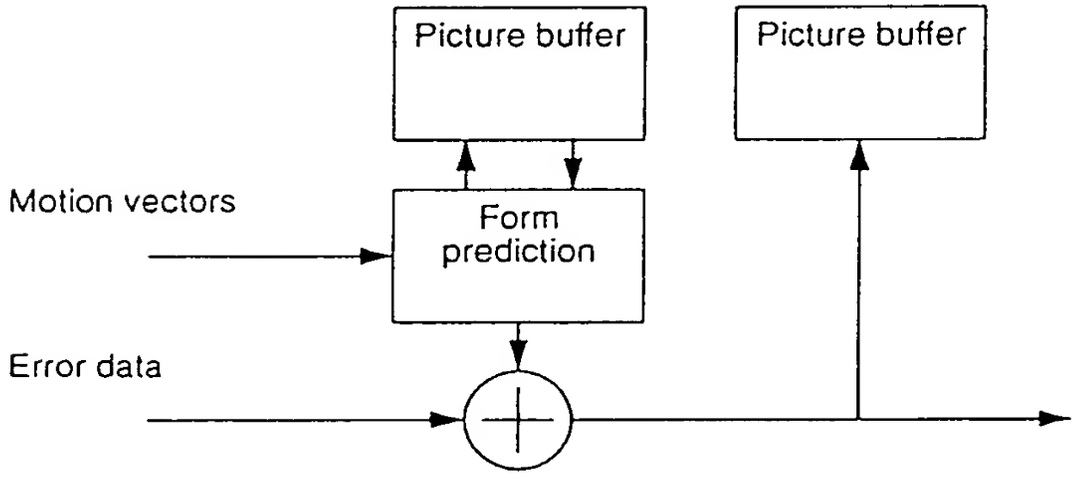


FIG.90

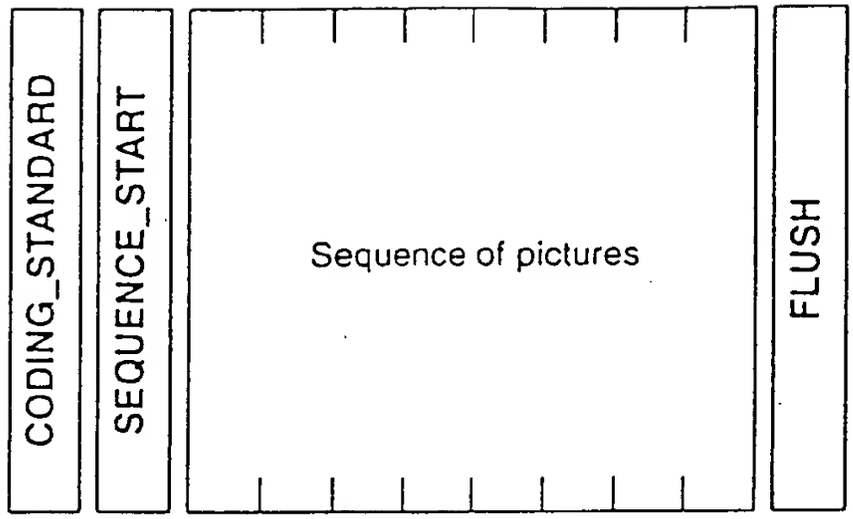

CODING_STANDARD
SEQUENCE_START
Sequence of pictures
FLUSH

FIG.91

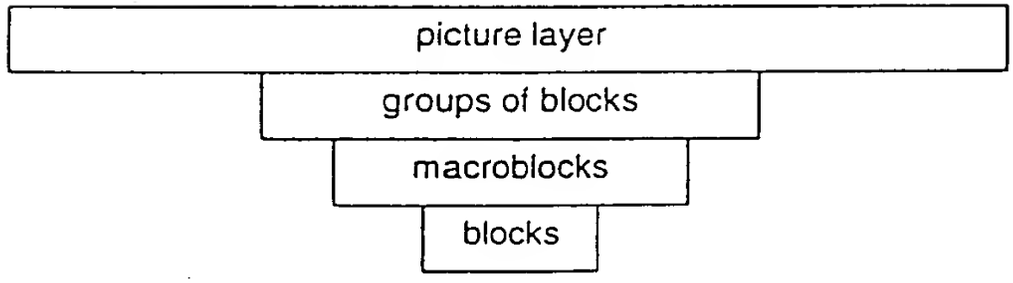

picture layer
groups of blocks
macroblocks
blocks

FIG.92

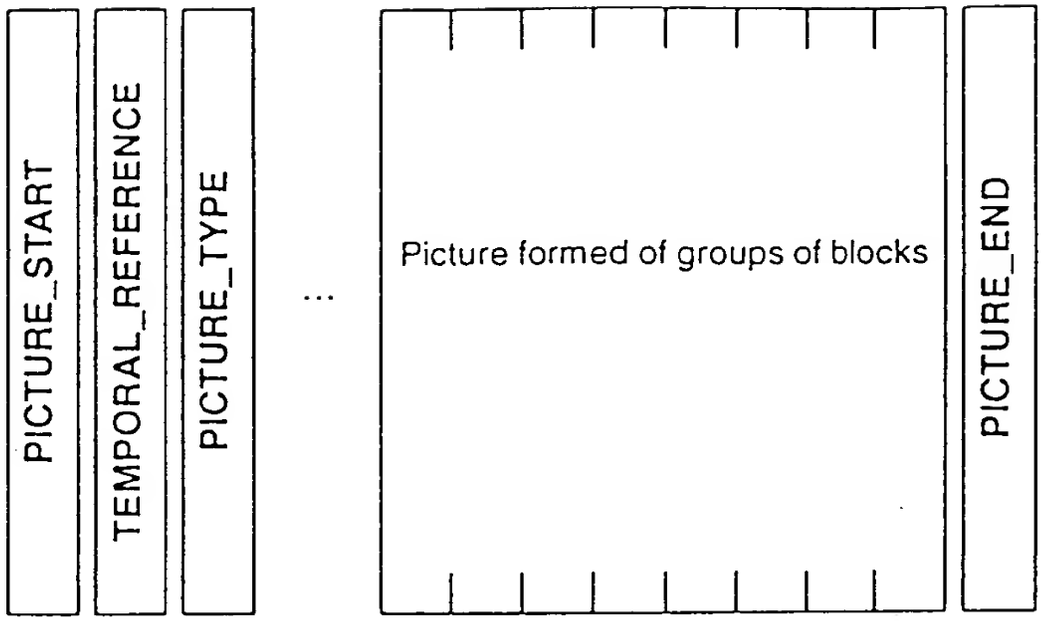


FIG.93

CIF

0	1
2	3
4	5
6	7
8	9
10	11

QCIF

0
2
4

FIG.94

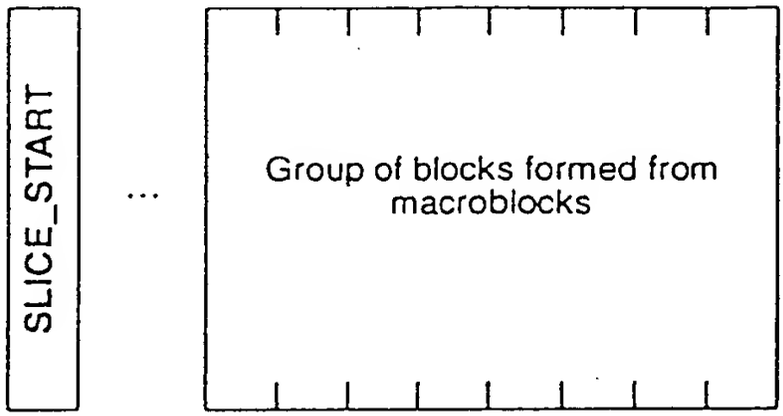


FIG.95

1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33

FIG.96

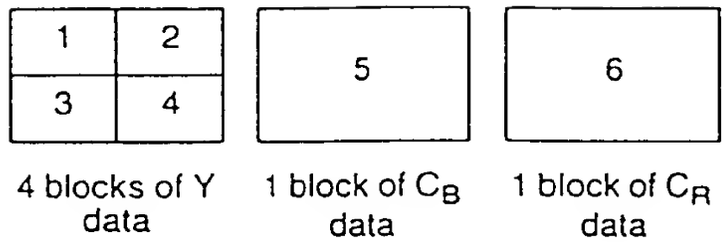

1
2
3
4
5
6
4 blocks of Y data
1 block of C_B data
1 block of C_R data

FIG.97

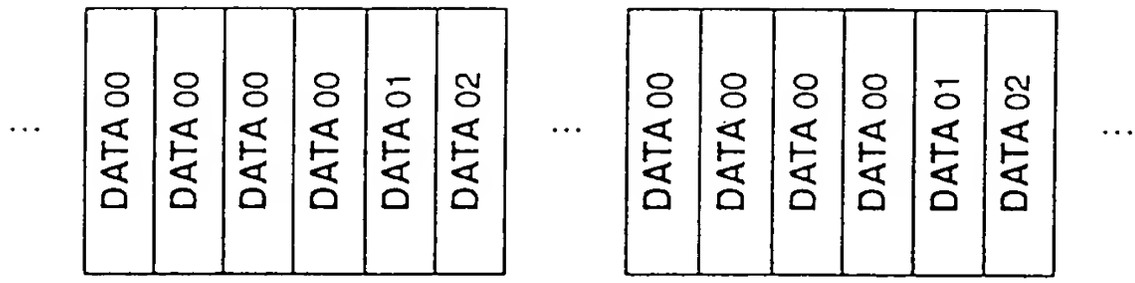

DATA 00
DATA 00
DATA 00
DATA 00
DATA 01
DATA 02
DATA 00
DATA 00
DATA 00
DATA 00
DATA 01
DATA 02

FIG.98

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16

59	58	59	60	61	62	63	64

FIG.99

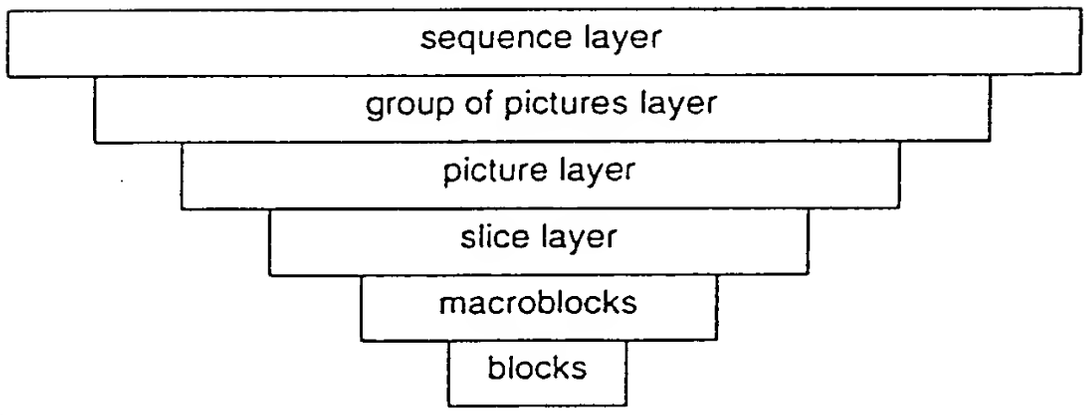


FIG. 100

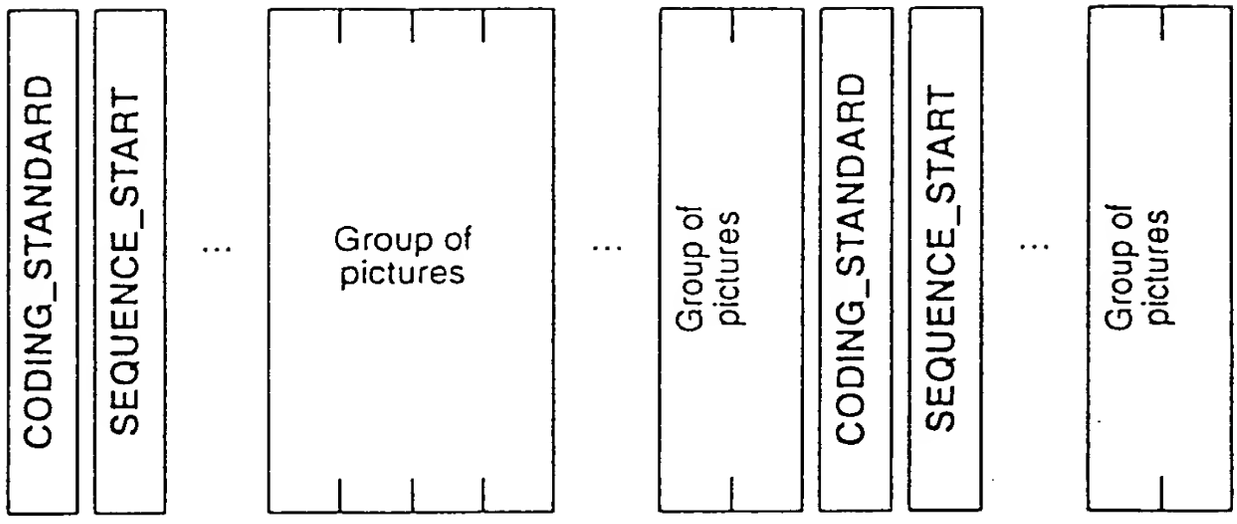


FIG. 101

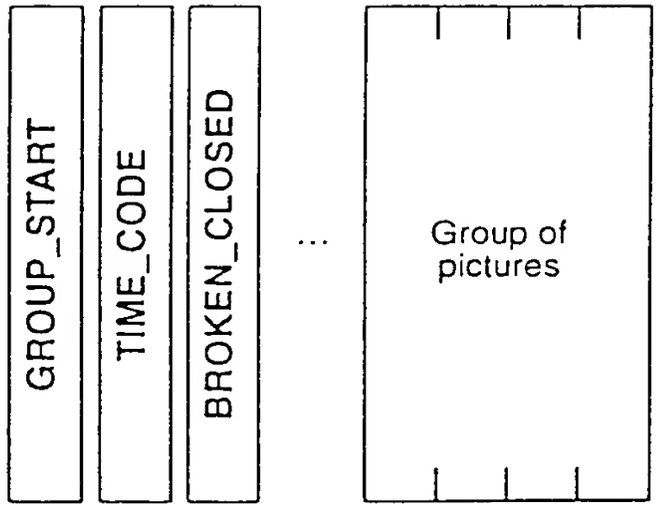


FIG. 102

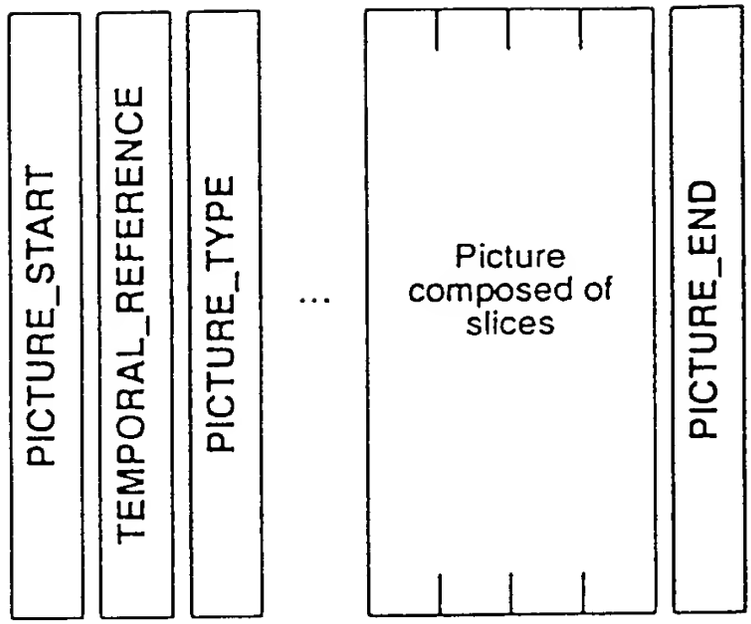


FIG. 103

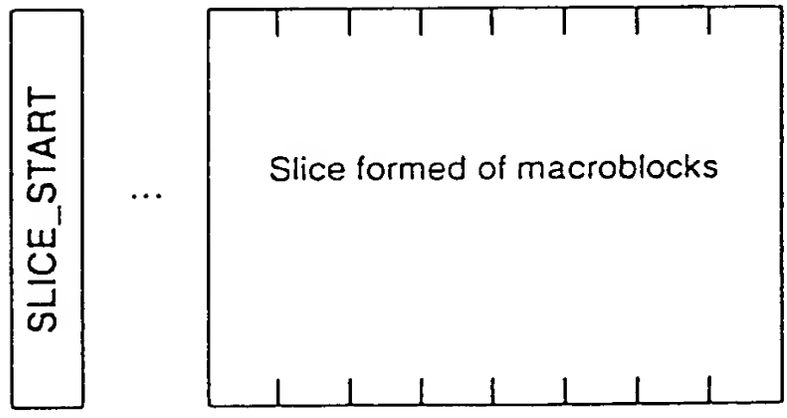


FIG. 104

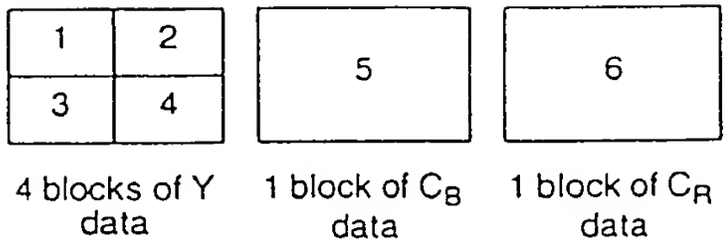


FIG. 105

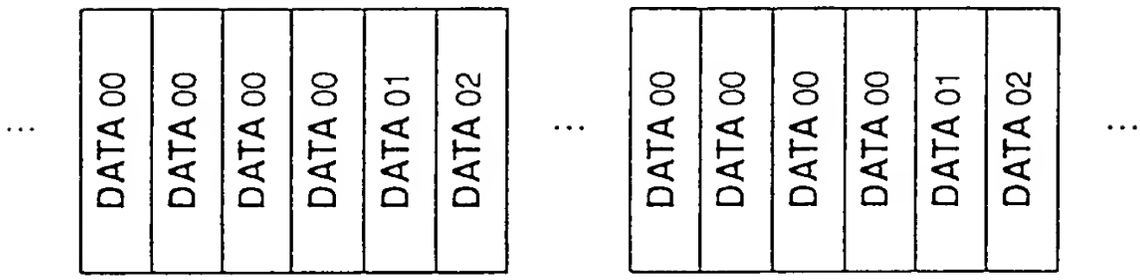


FIG. 106

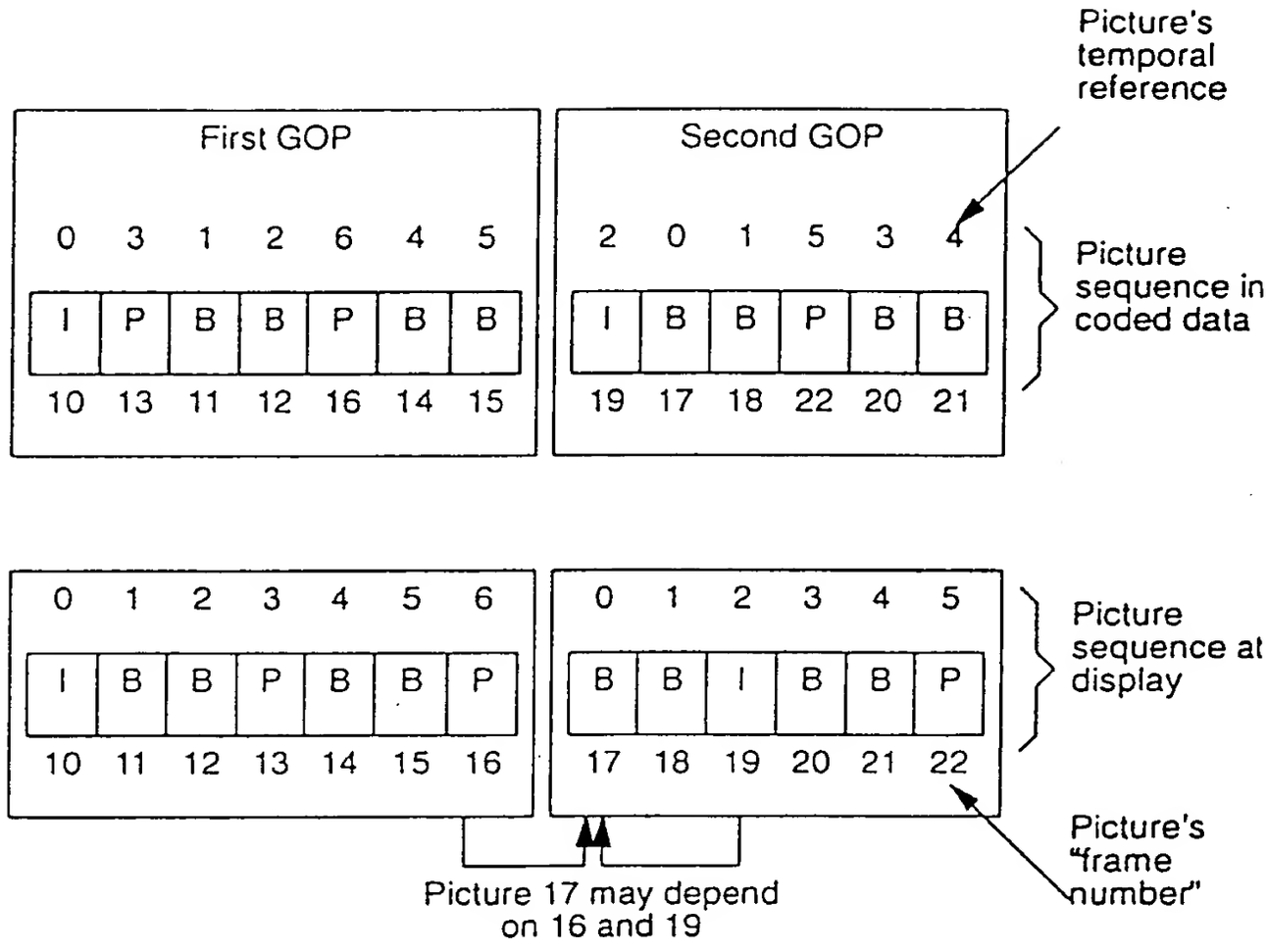

Picture's temporal reference
First GOP
Second GOP
0 3 1 2 6 4 5
I P B B P B B
10 13 11 12 16 14 15
2 0 1 5 3 4
I B B P B B
19 17 18 22 20 21
Picture sequence in coded data
0 1 2 3 4 5 6
I B B P B B P
10 11 12 13 14 15 16
0 1 2 3 4 5
B B I B B P
17 18 19 20 21 22
Picture sequence at display
Picture's "frame number"
Picture 17 may depend on 16 and 19

FIG. 107

FIG. 108

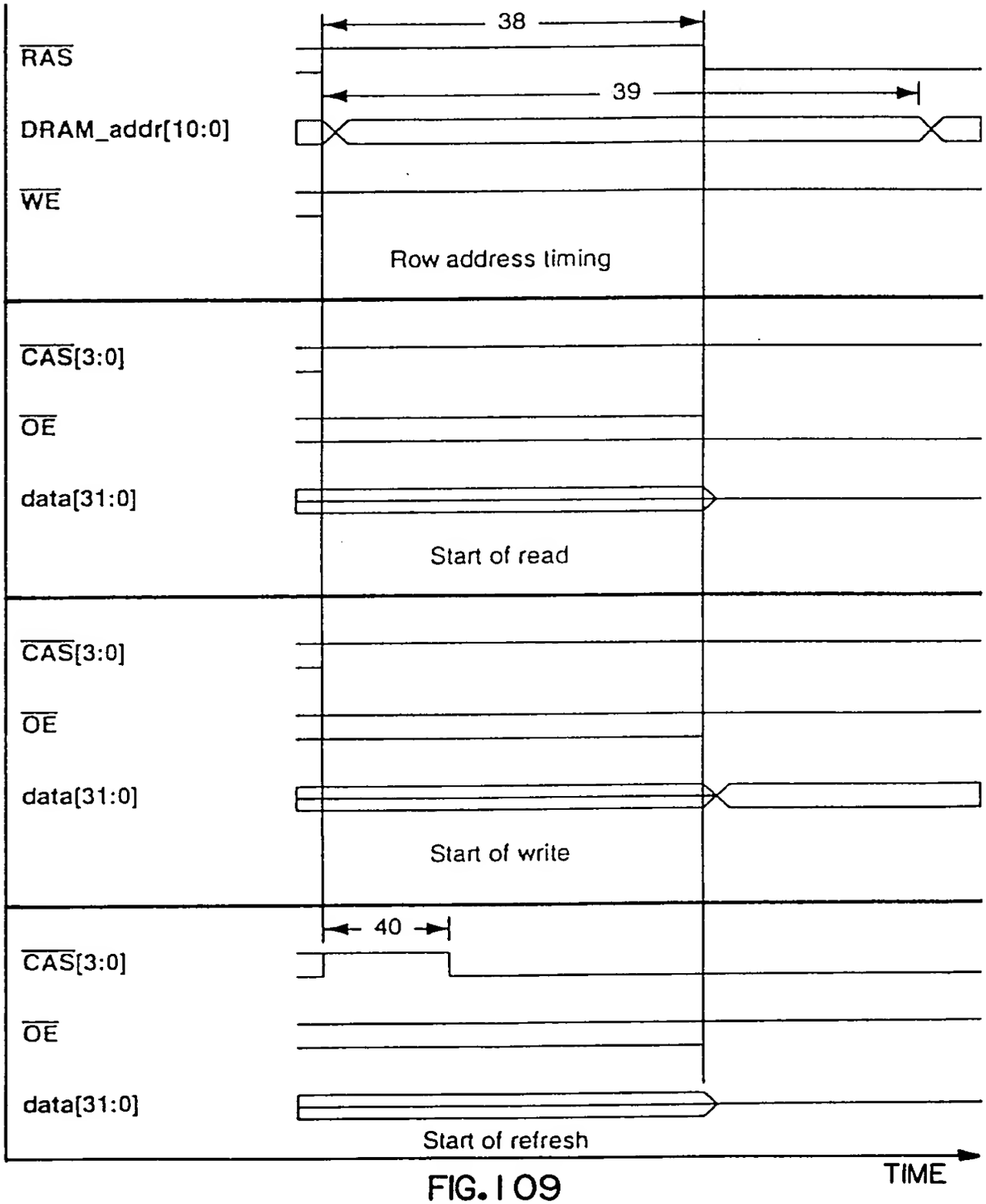


FIG. 109

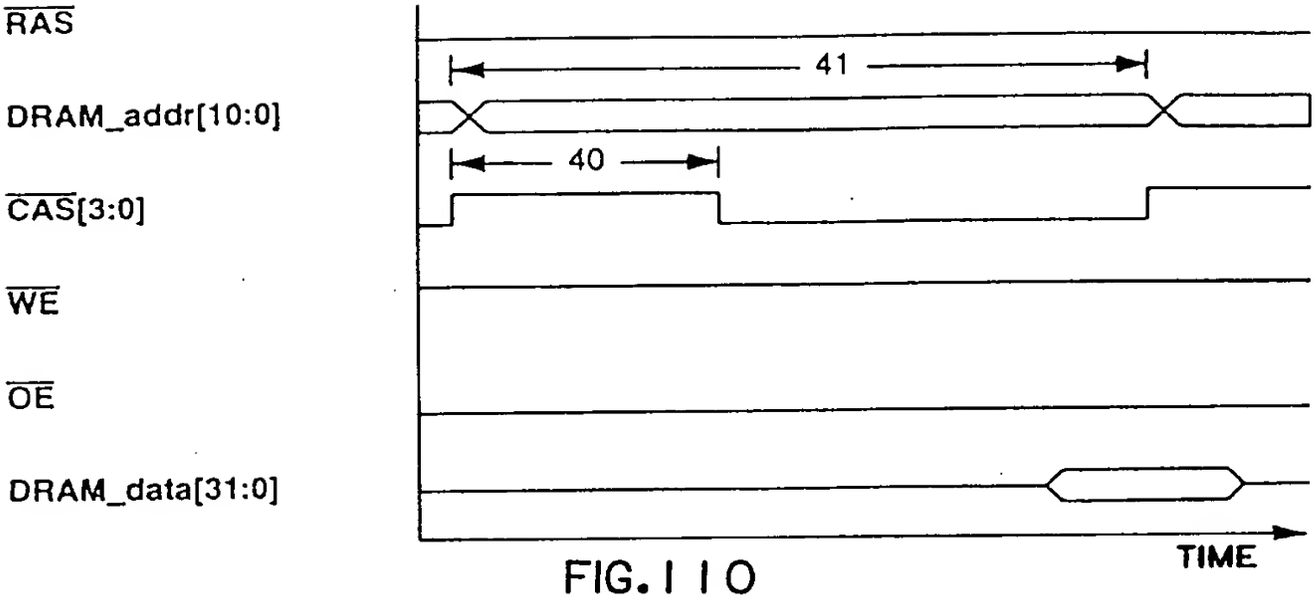


FIG. 110

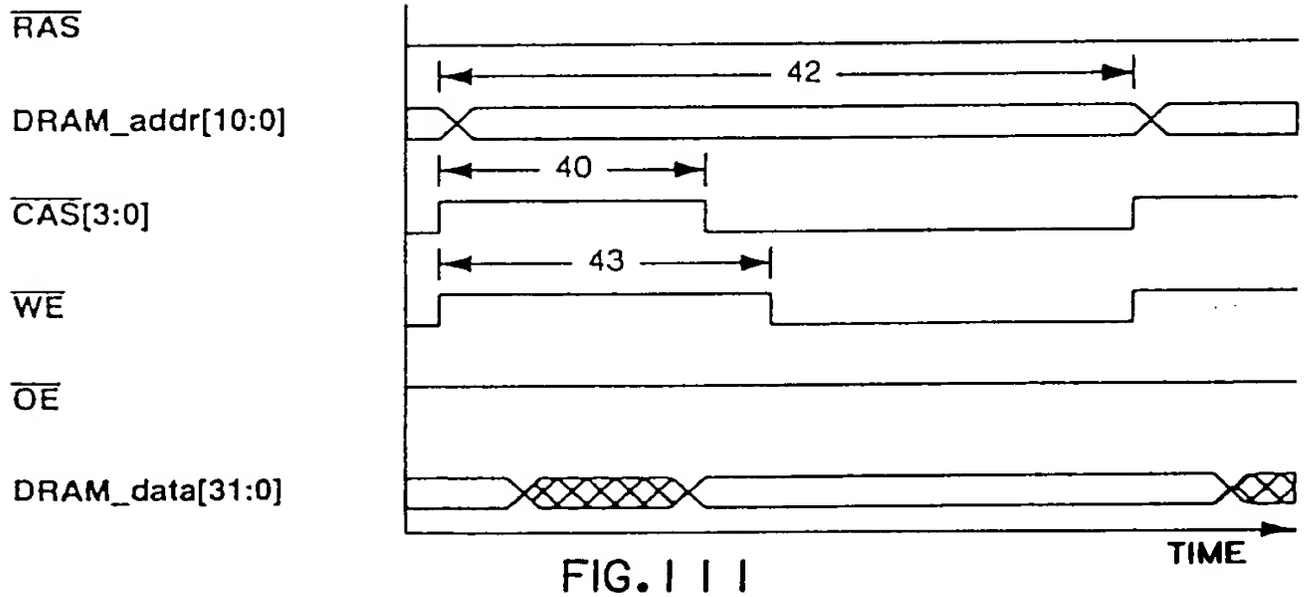


FIG. 111

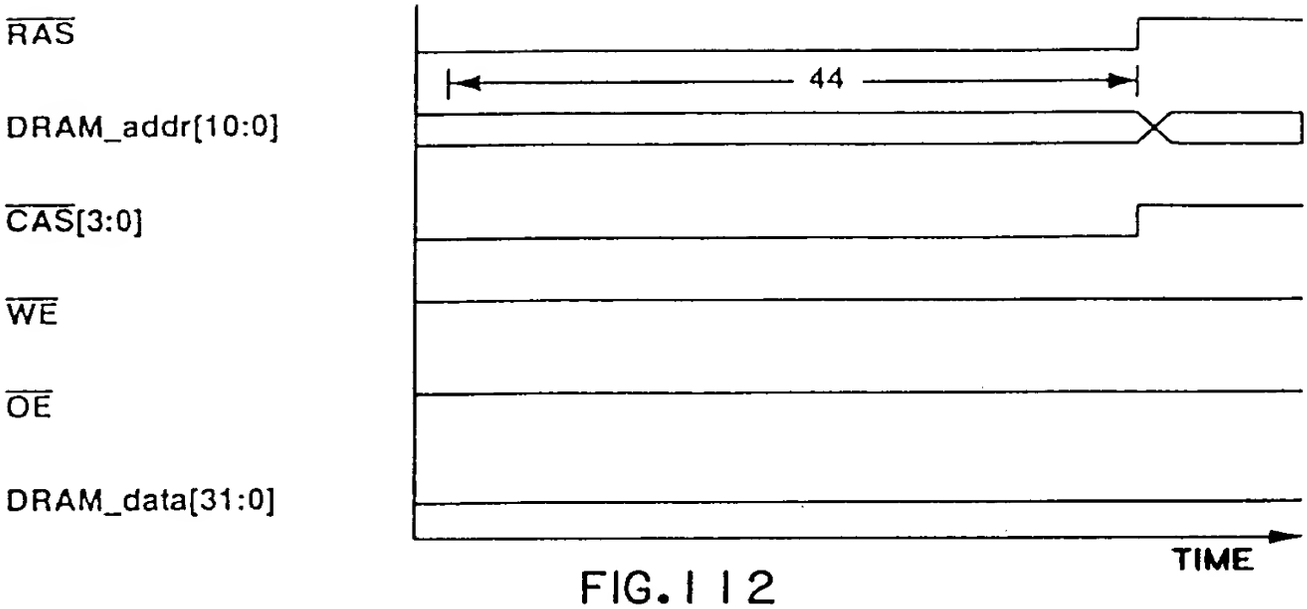


FIG. 112

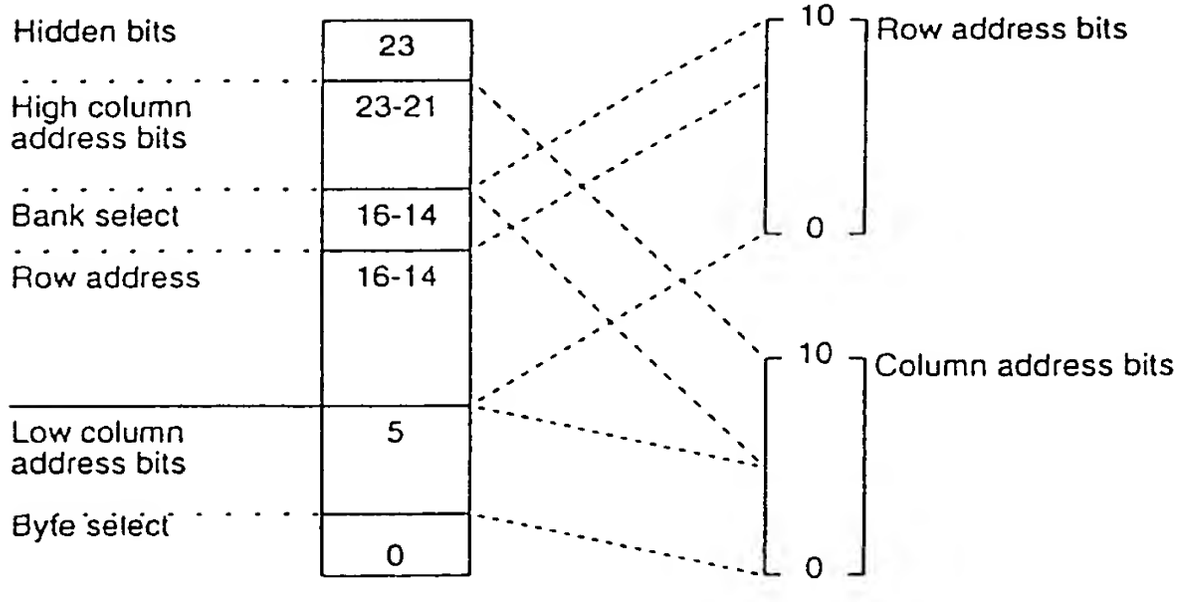


FIG. 113

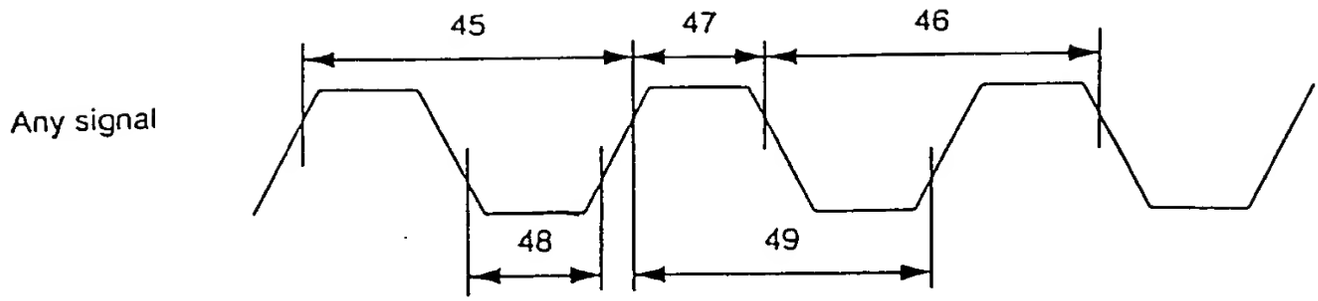


FIG. 114

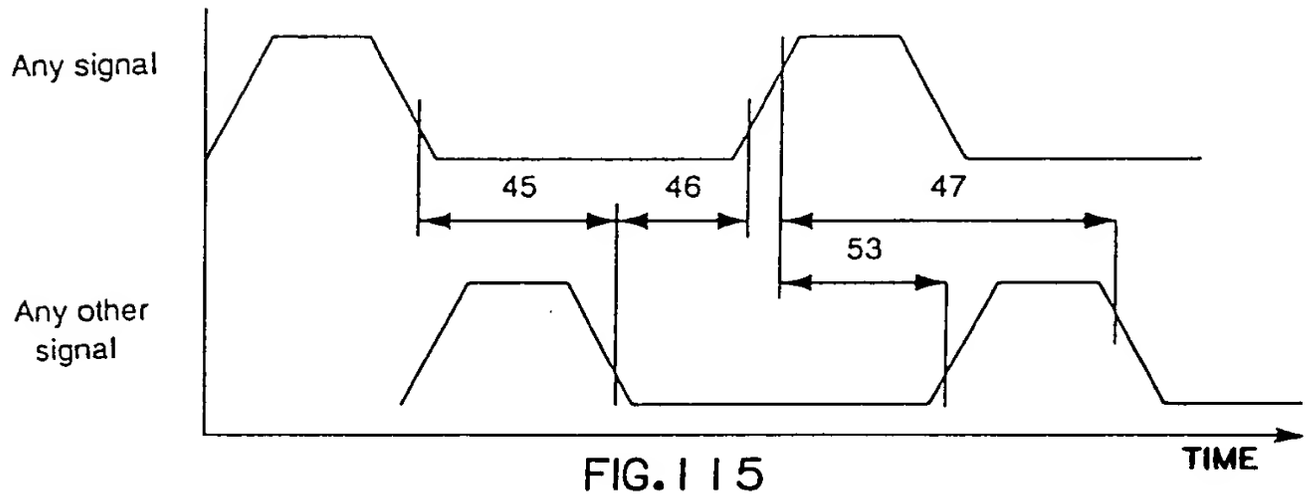


FIG. 115

FOREGROUND 6,216,236

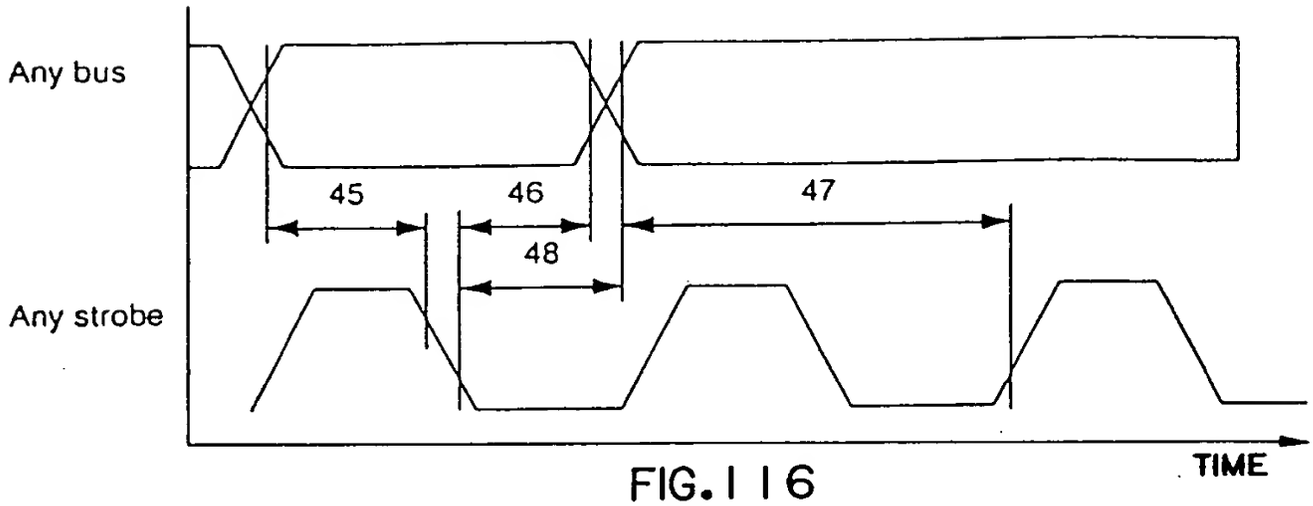


FIG. 116

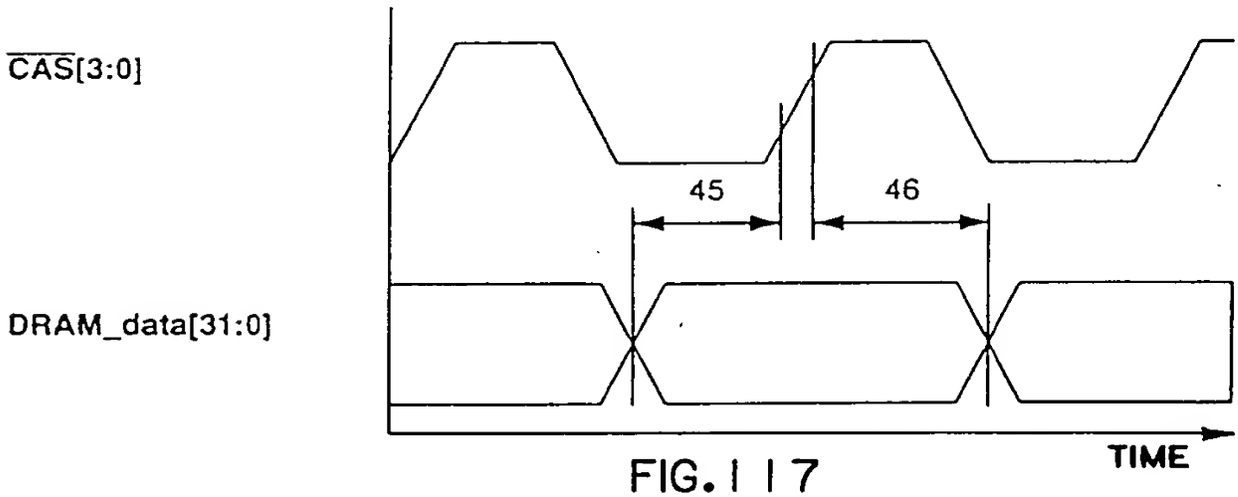


FIG. 117

TOTO20 "2ZHE2260

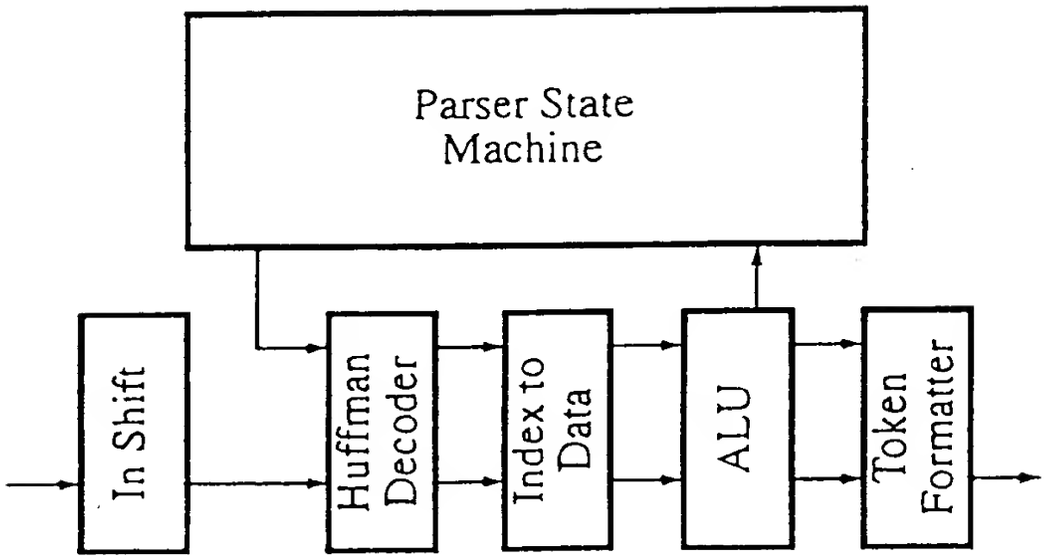


FIG. 118

EP 0 525 625 A2

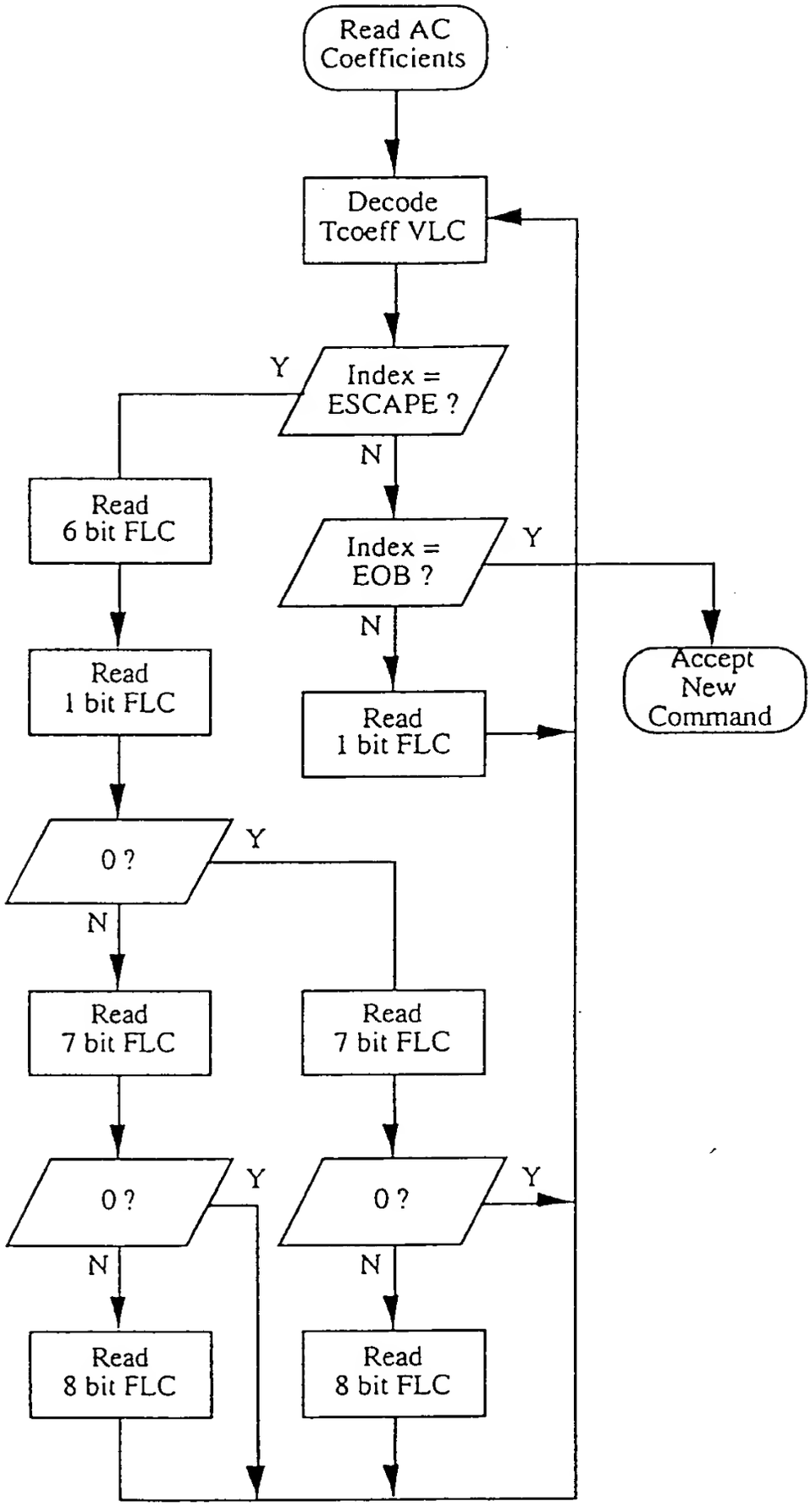


FIG. 119

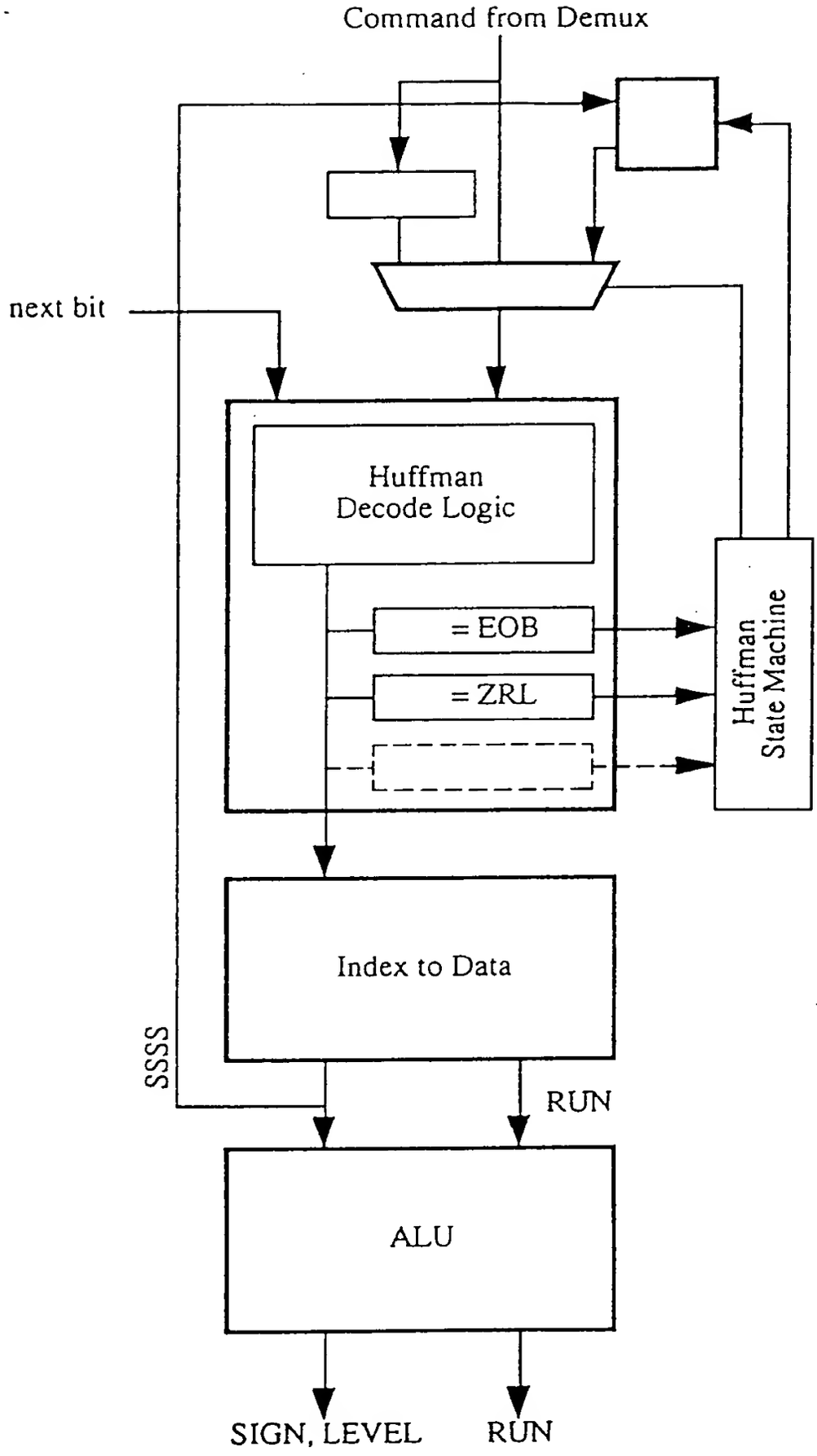

Command from Demux
next bit
Huffman
Decode Logic
= EOB
= ZRL
Huffman
State Machine
Index to Data
SSSS
RUN
ALU
SIGN, LEVEL
RUN

FIG. 120

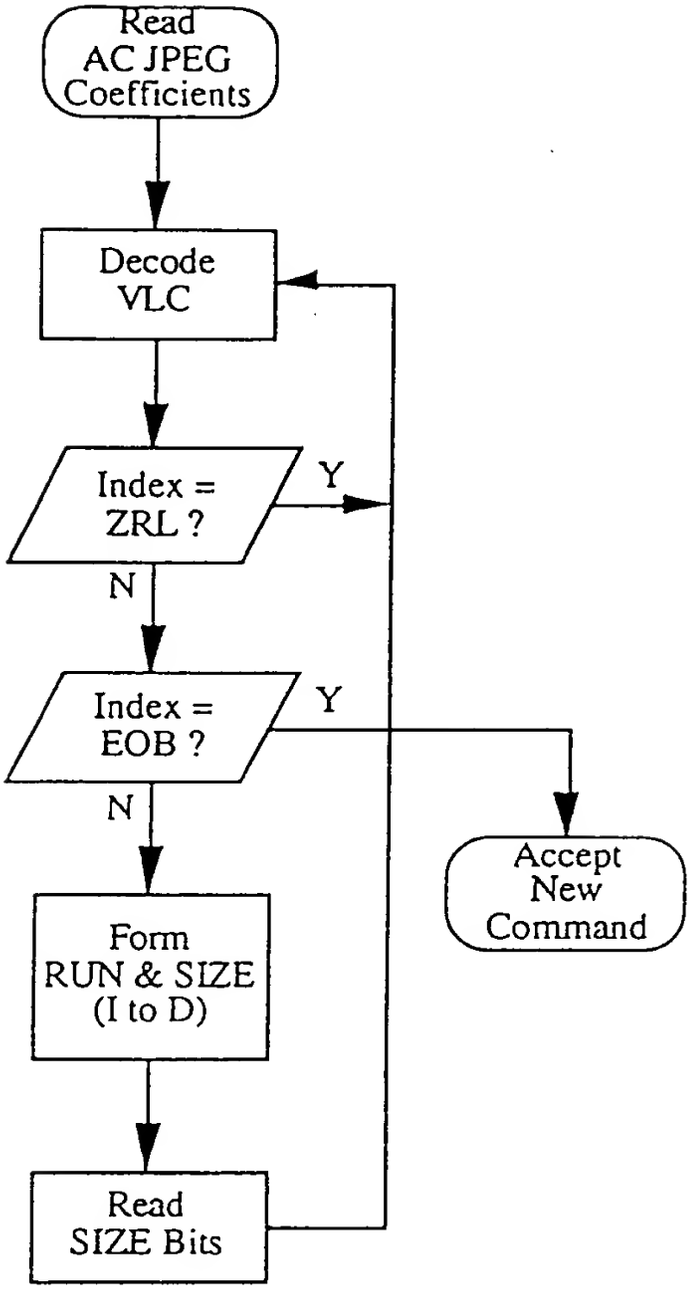


FIG. 121A

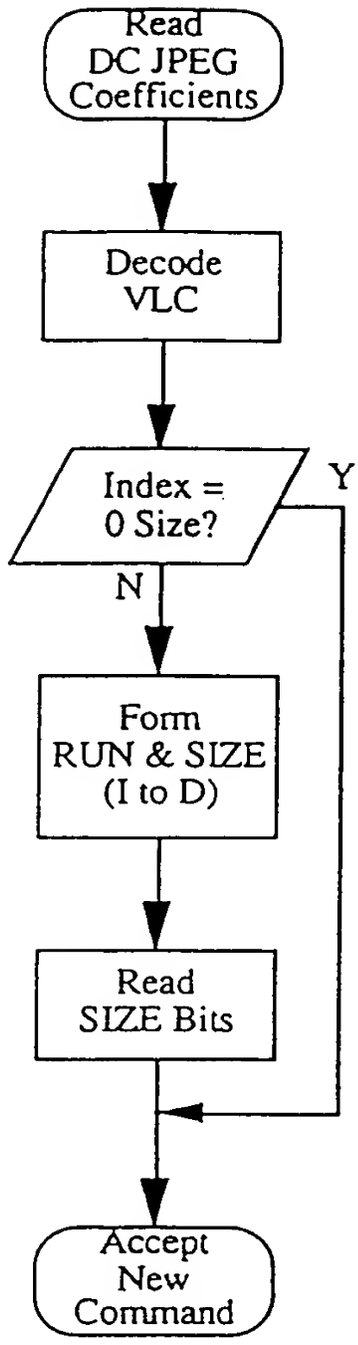


FIG. 121B

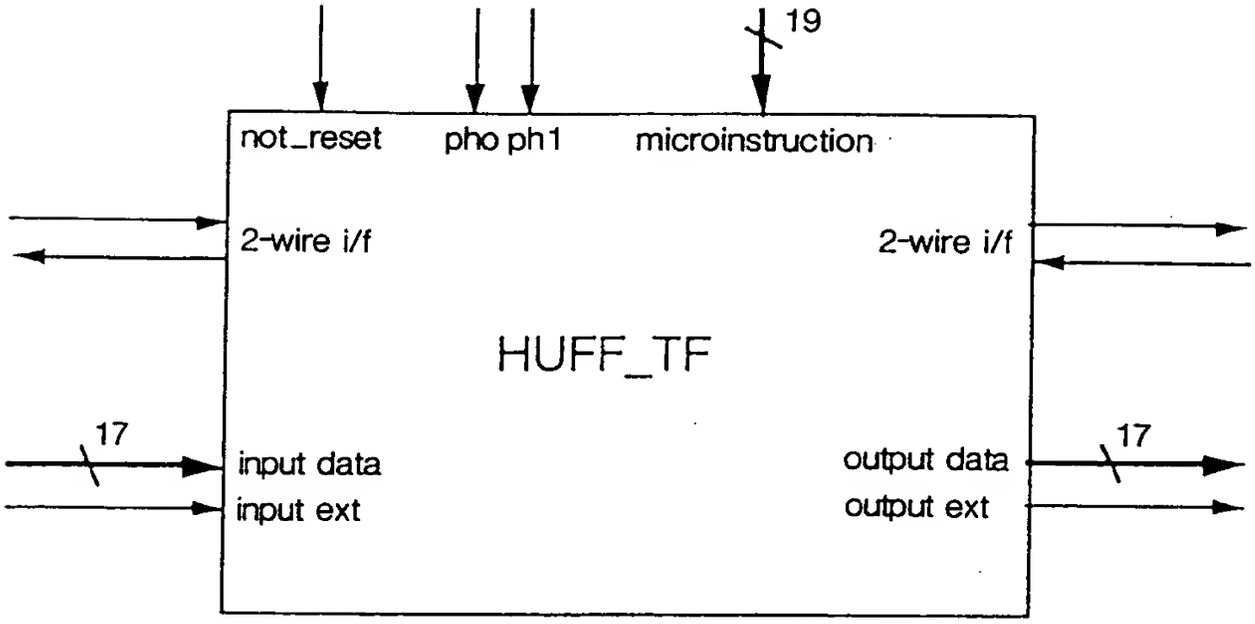


FIG. 122

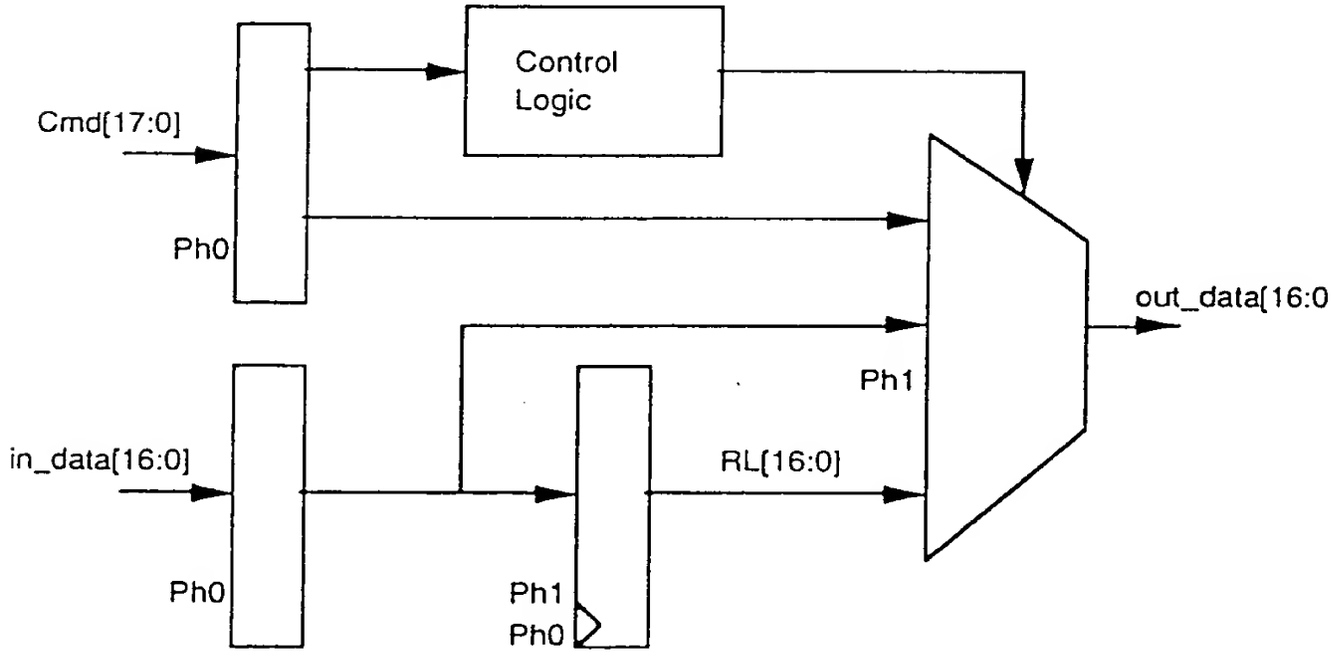


FIG. 123

PD10020 E2HE4260

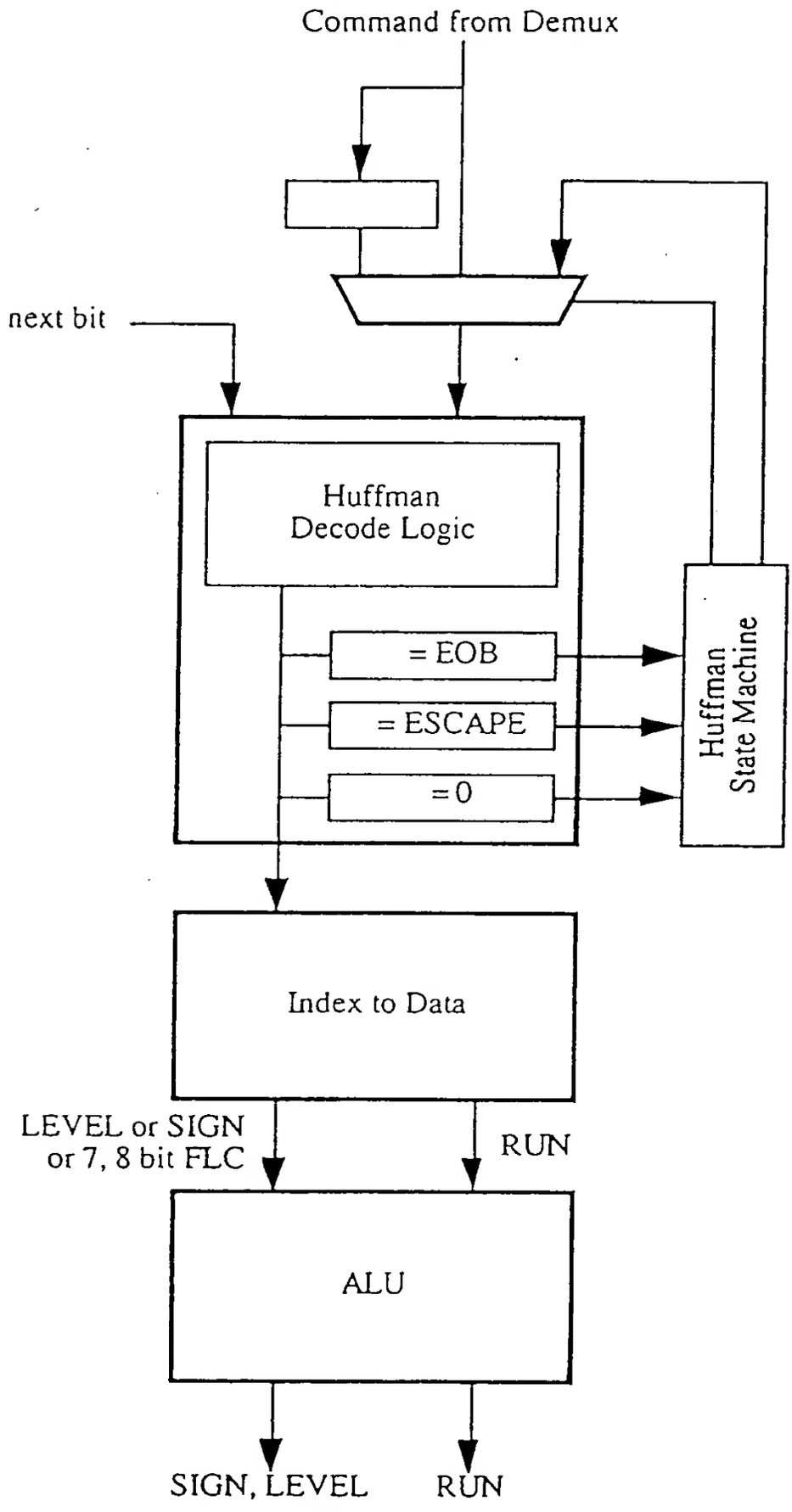


FIG. 124

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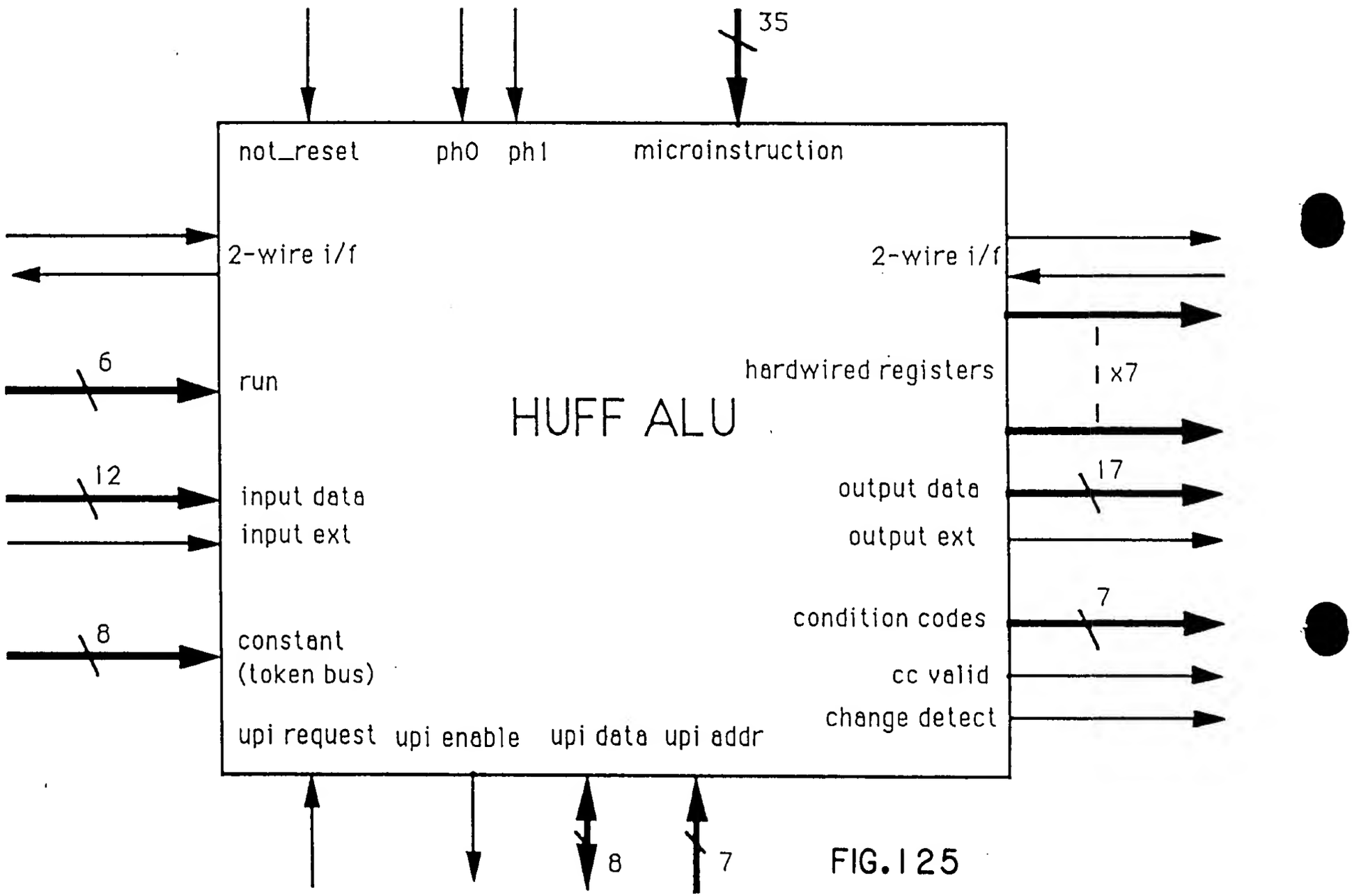


FIG. 125

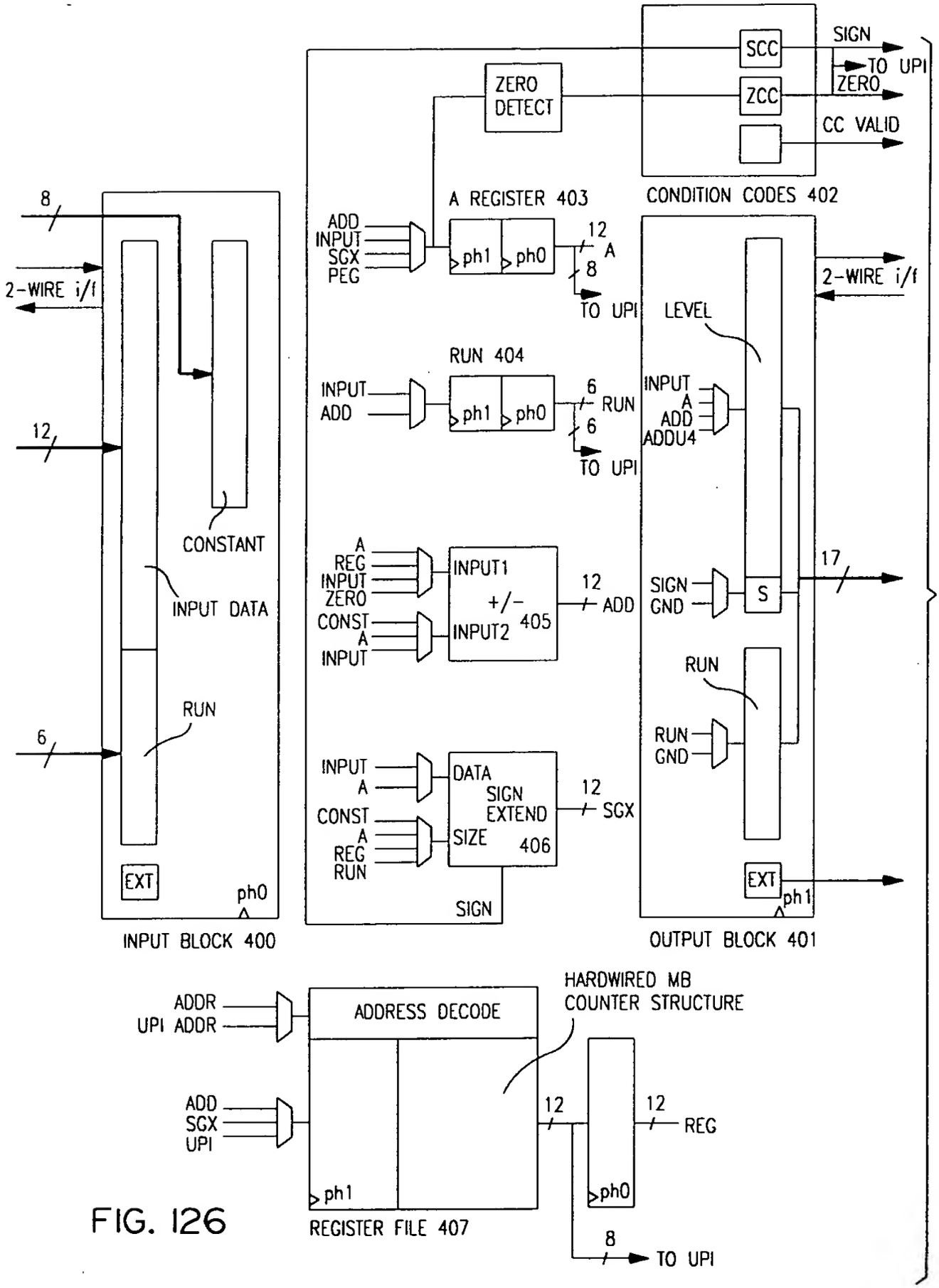

8
2-WIRE i/f
12
6
CONSTANT
INPUT DATA
RUN
EXT
ph0
INPUT BLOCK 400
ZERO DETECT
SCC
ZCC
SIGN
TO UPI
ZERO
CC VALID
CONDITION CODES 402
A REGISTER 403
ADD
INPUT
SGX
PEG
ph1
ph0
12
A
8
TO UPI
RUN 404
INPUT
ADD
6
RUN
6
TO UPI
A
REG
INPUT
ZERO
CONST
A
INPUT
INPUT1
+/-
INPUT2
405
12
ADD
INPUT
A
CONST
A
REG
RUN
DATA
SIGN
EXTEND
SIZE
406
12
SGX
SIGN
LEVEL
INPUT
A
ADD
ADDU4
2-WIRE i/f
17
SIGN
GND
S
RUN
RUN
GND
EXT
ph1
OUTPUT BLOCK 401
HARDWIRED MB
COUNTER STRUCTURE
ADDR
UPI ADDR
ADDRESS DECODE
ADD
SGX
UPI
ph1
12
12
REG
ph0
8
TO UPI
REGISTER FILE 407

FIG. 126

PCT/US95/12260

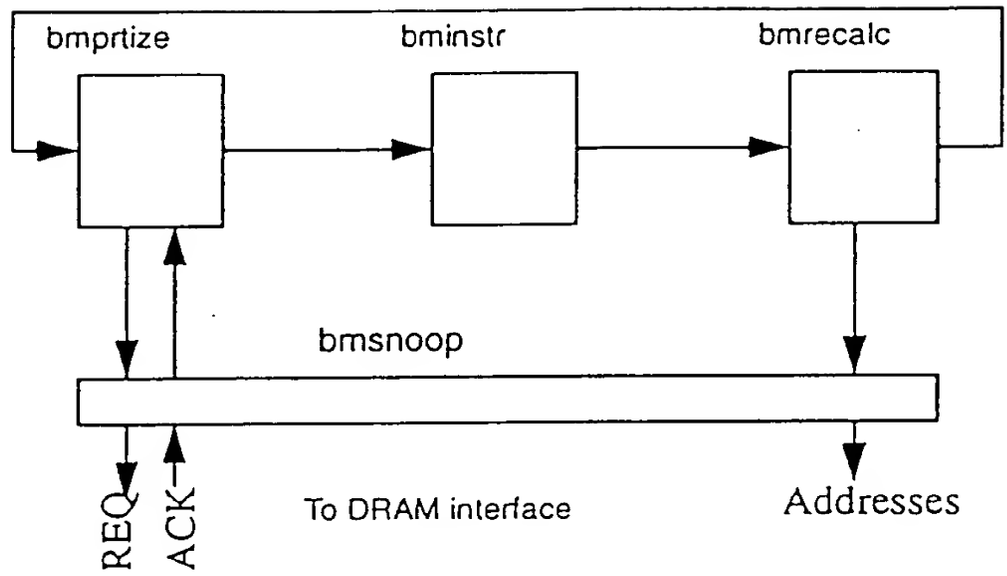


FIG. 127

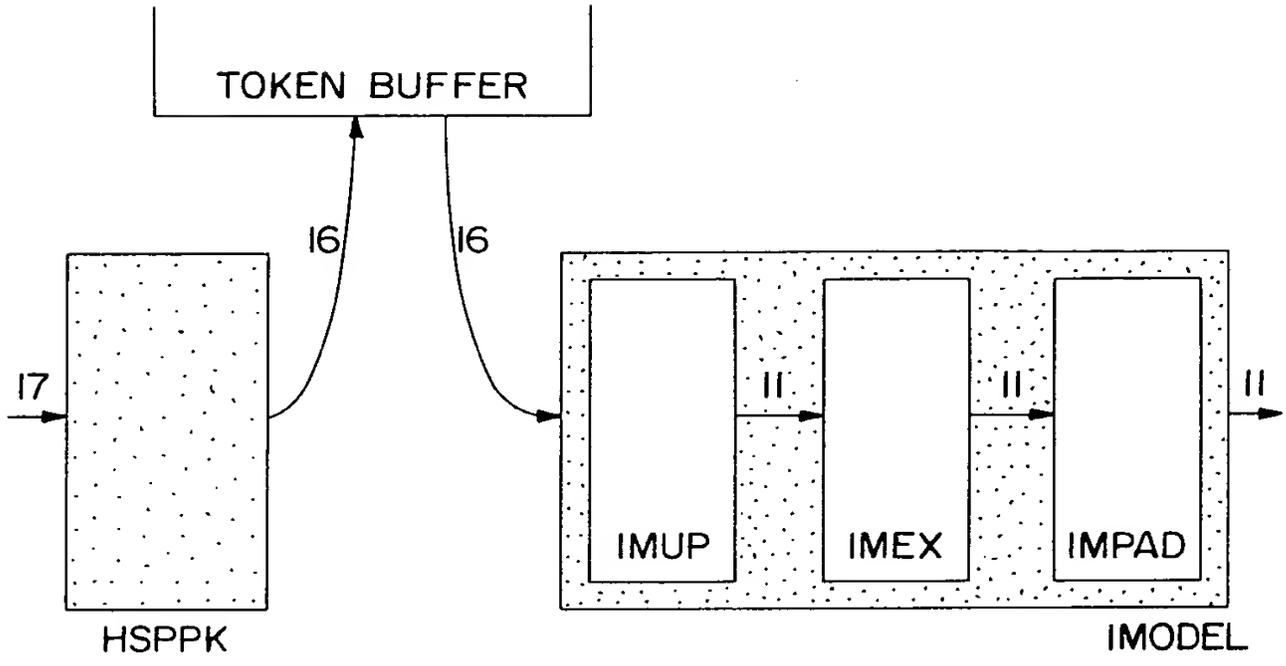


FIG. 128

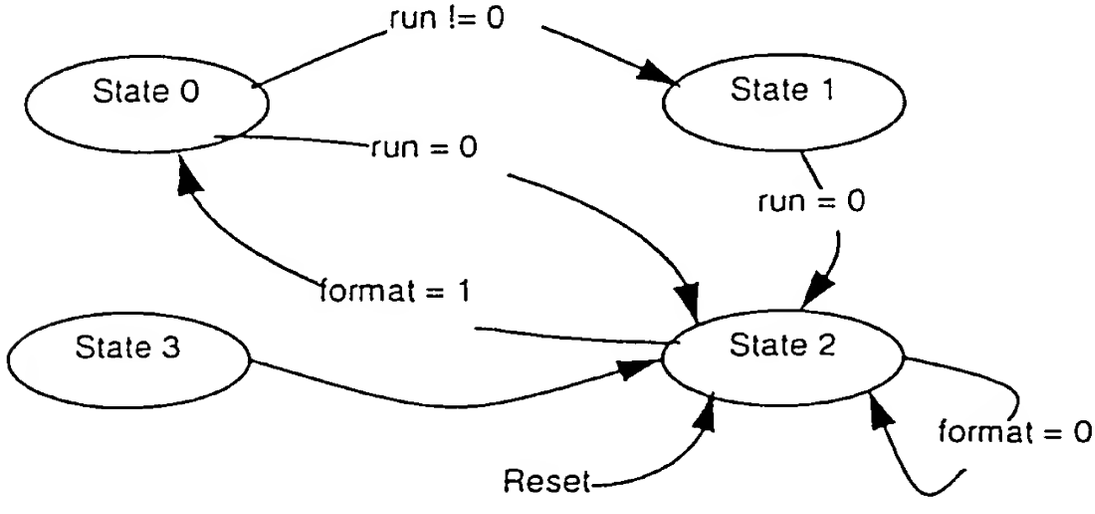


FIG. 129

TOTO20 "EZHEZ260

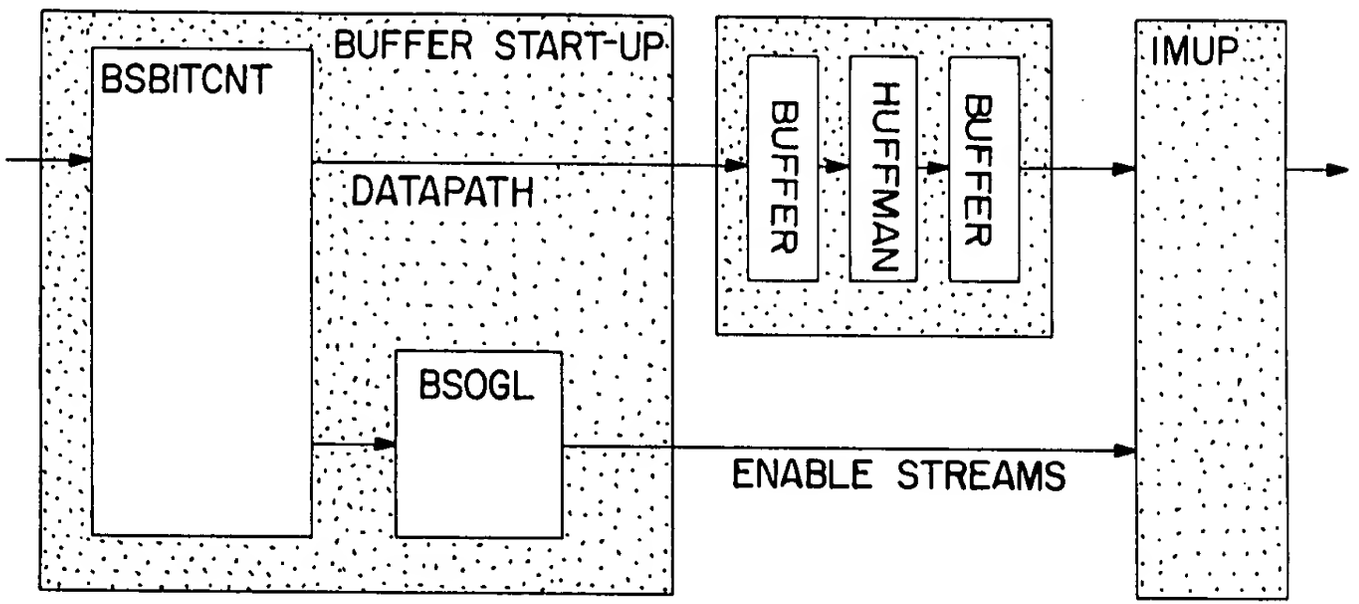


FIG. 130

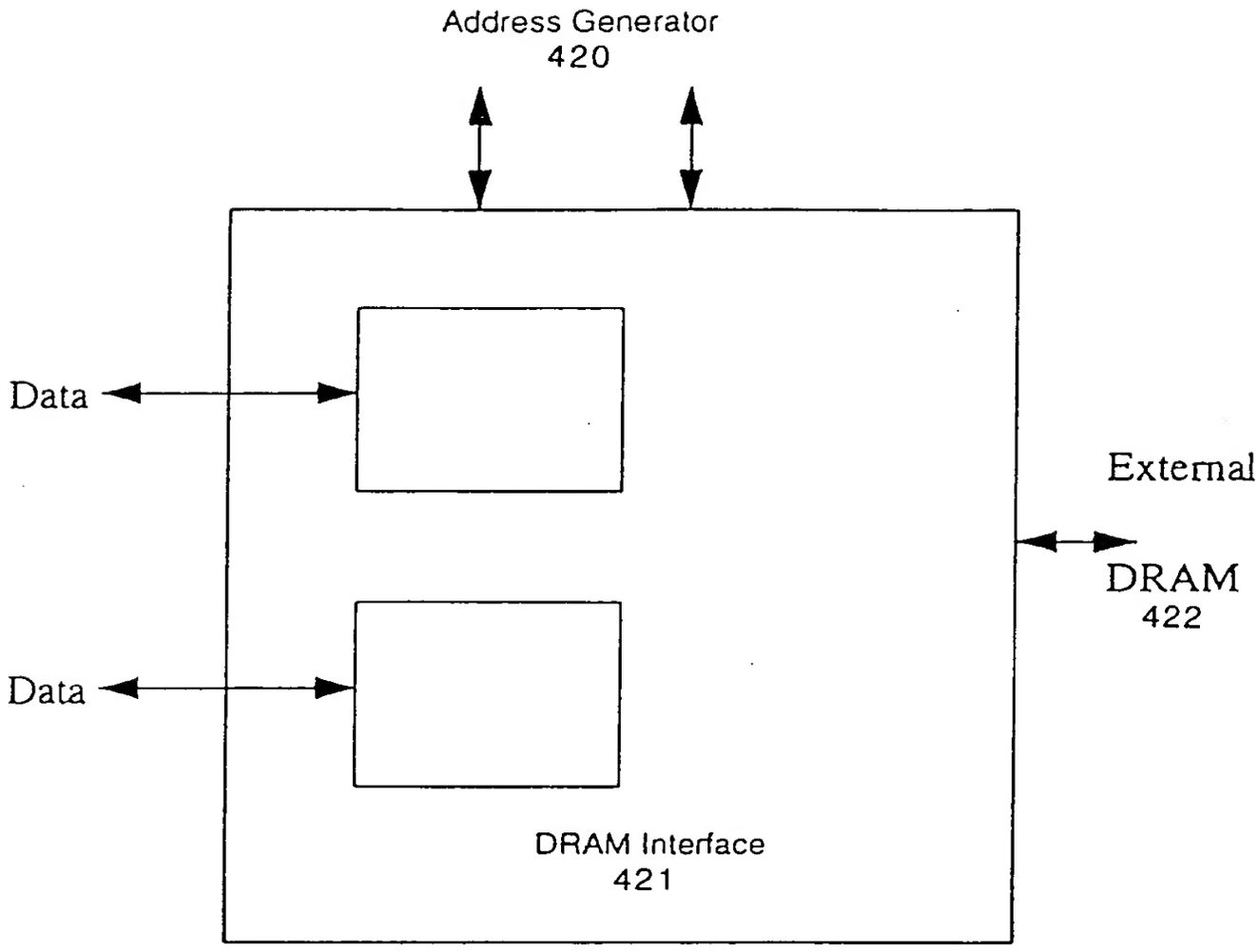

Address Generator
420
Data
Data
External
DRAM
422
DRAM Interface
421

FIG. 131

FOREIGN PATENT 2

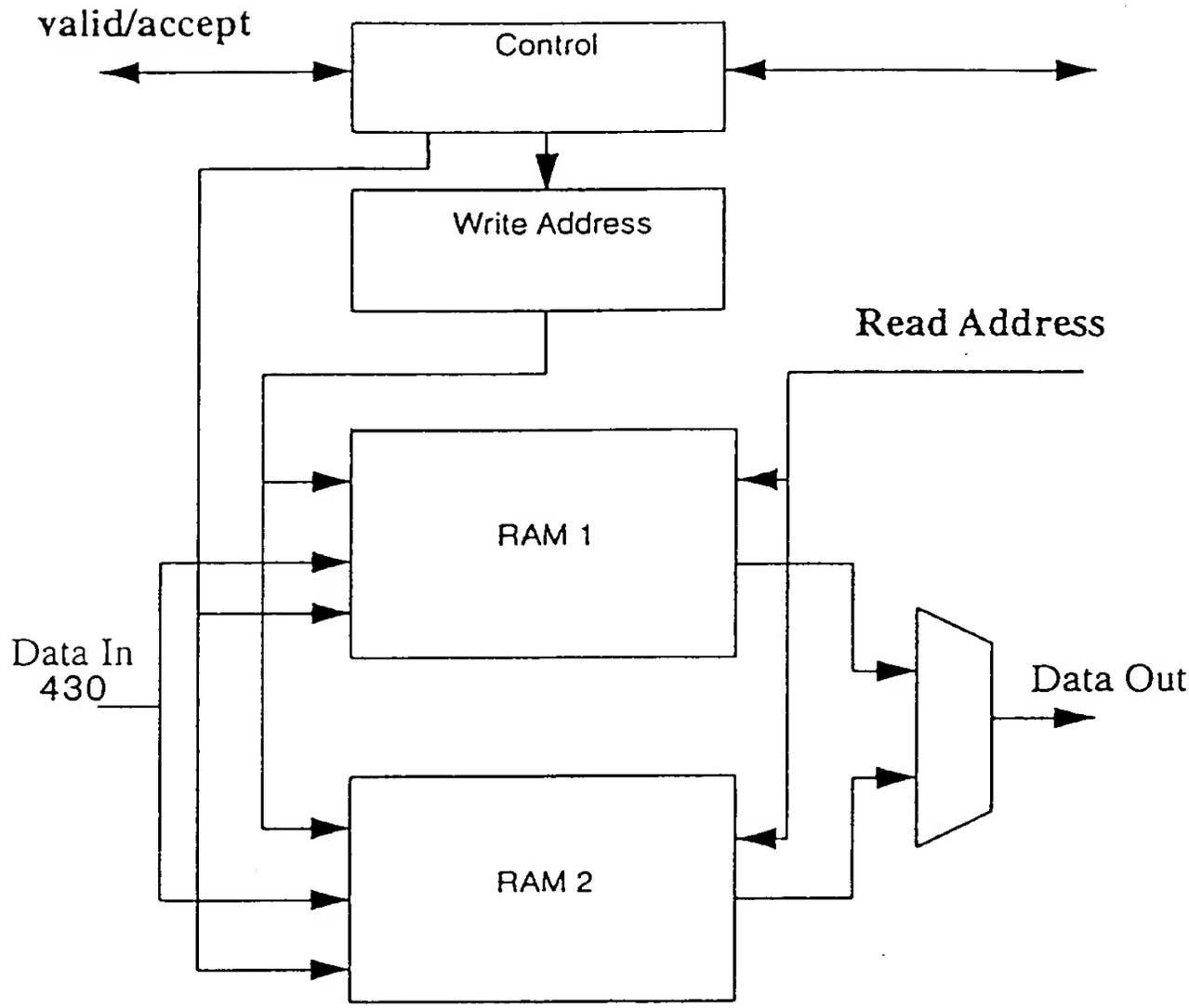


FIG. 132

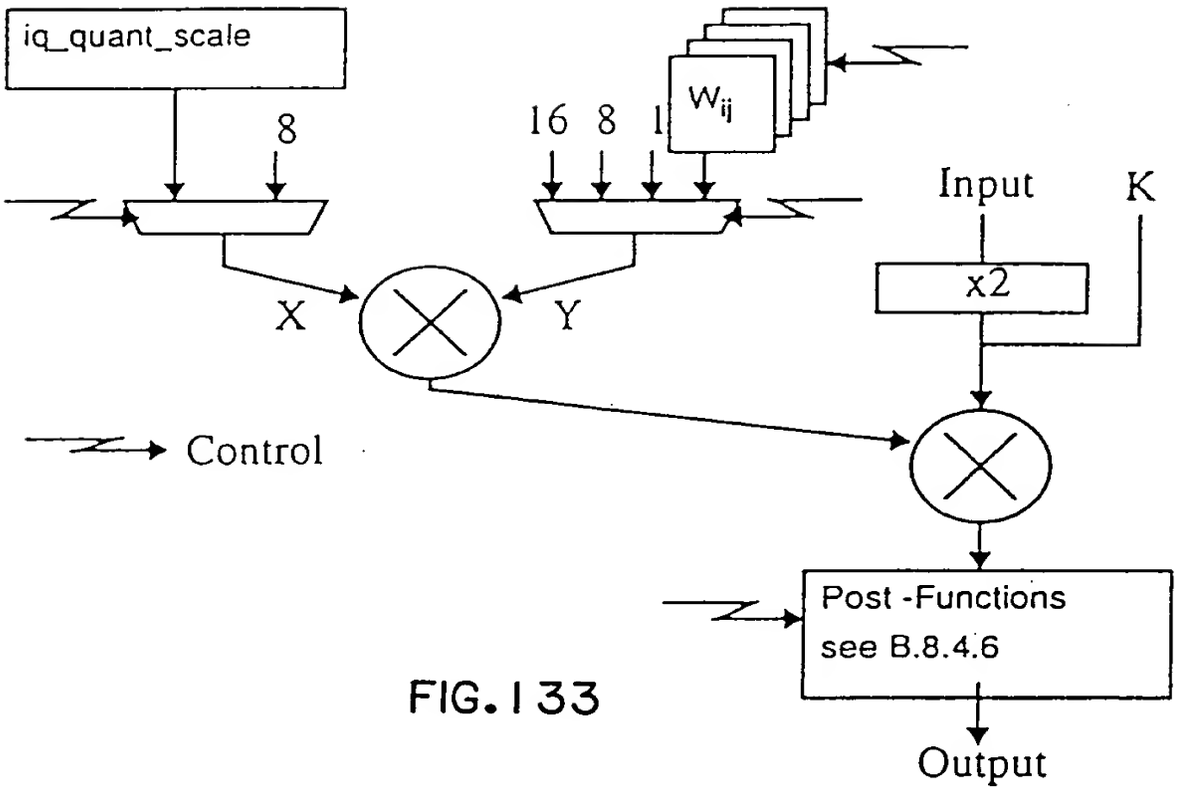


FIG. 133

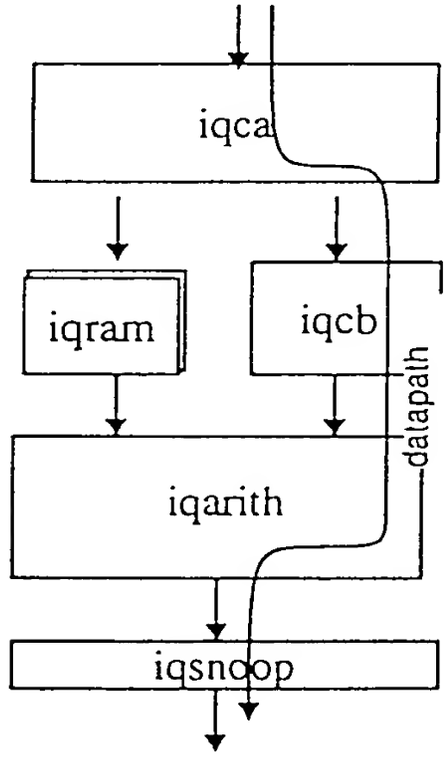


FIG. 134

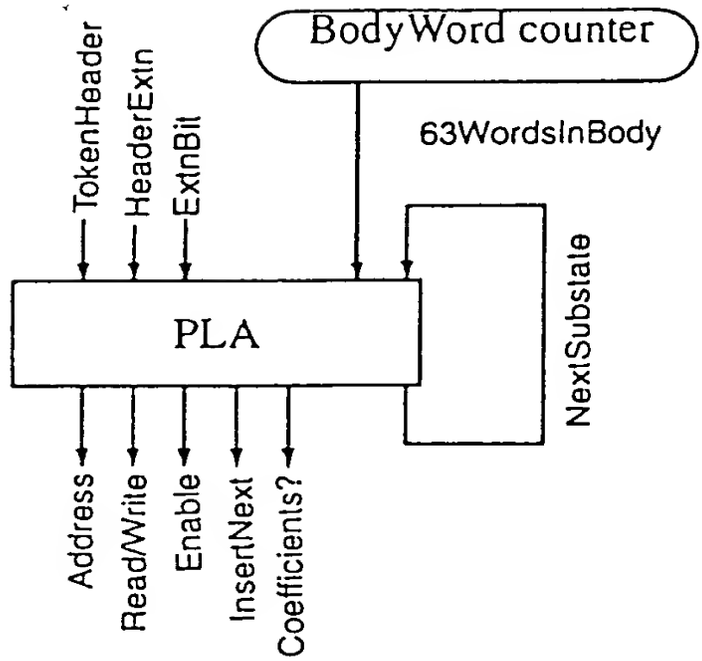

BodyWord counter
63WordsInBody
TokenHeader
HeaderExtn
ExtnBit
PLA
NextSubstate
Address
Read/Write
Enable
InsertNext
Coefficients?

FIG. 135

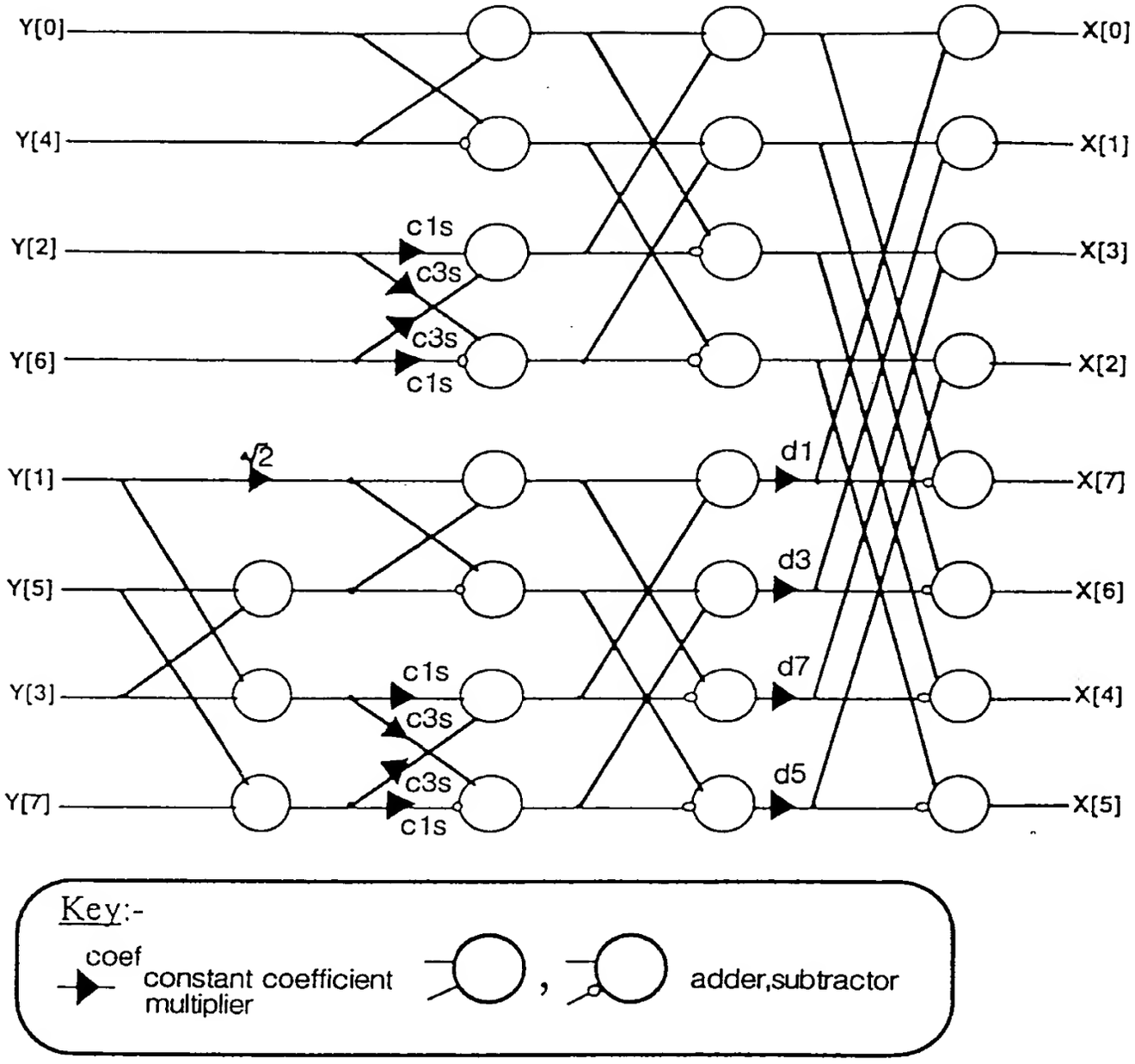

Y[0]
Y[4]
Y[2]
Y[6]
Y[1]
Y[5]
Y[3]
Y[7]
X[0]
X[1]
X[3]
X[2]
X[7]
X[6]
X[4]
X[5]
c1s
c3s
c3s
c1s
√2
d1
d3
d7
d5
c1s
c3s
c3s
c1s
Key:-
coef
constant coefficient multiplier
adder,subtractor

FIG. 136

PCT/GB2003/004560

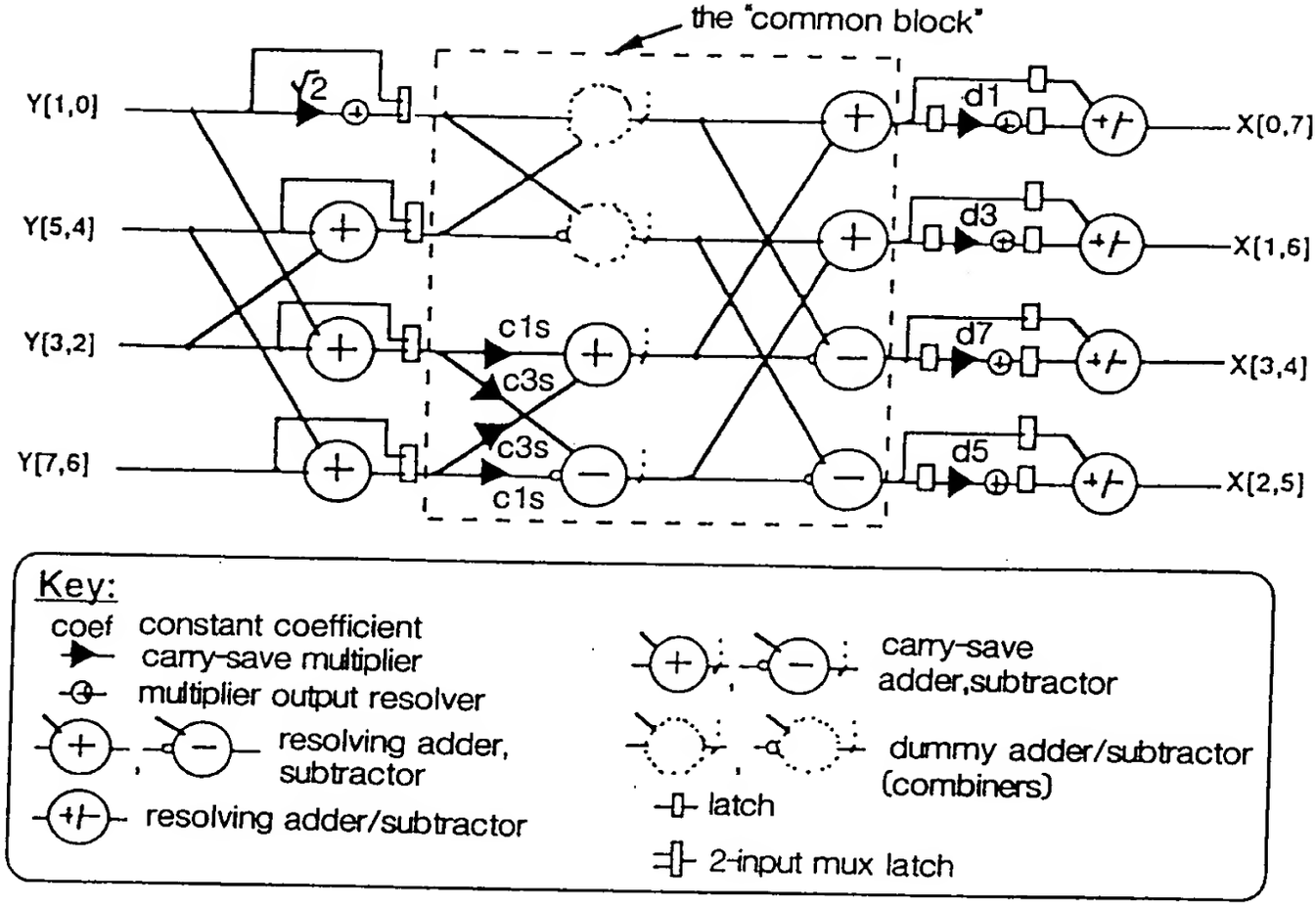


FIG. 137

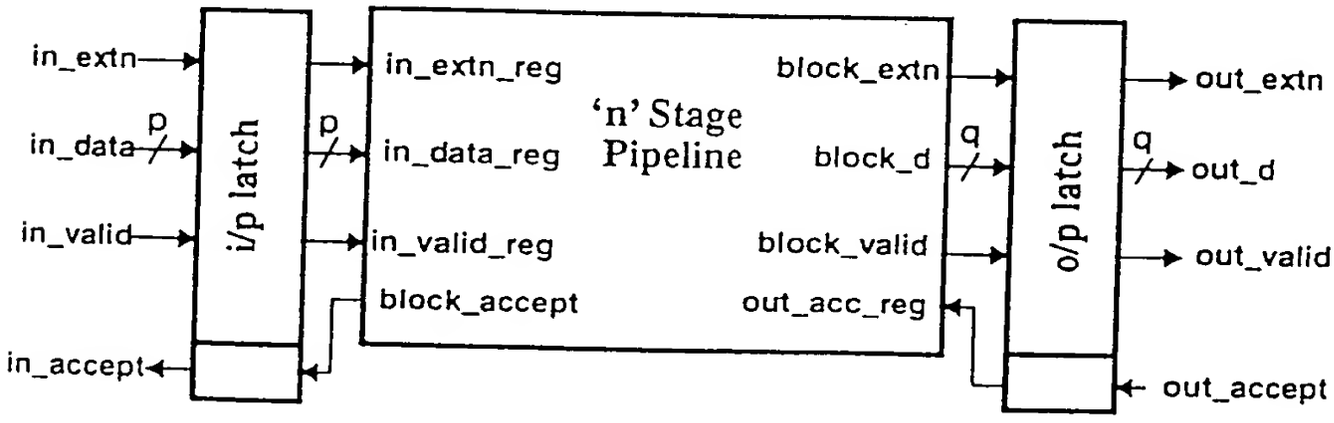


FIG. 138

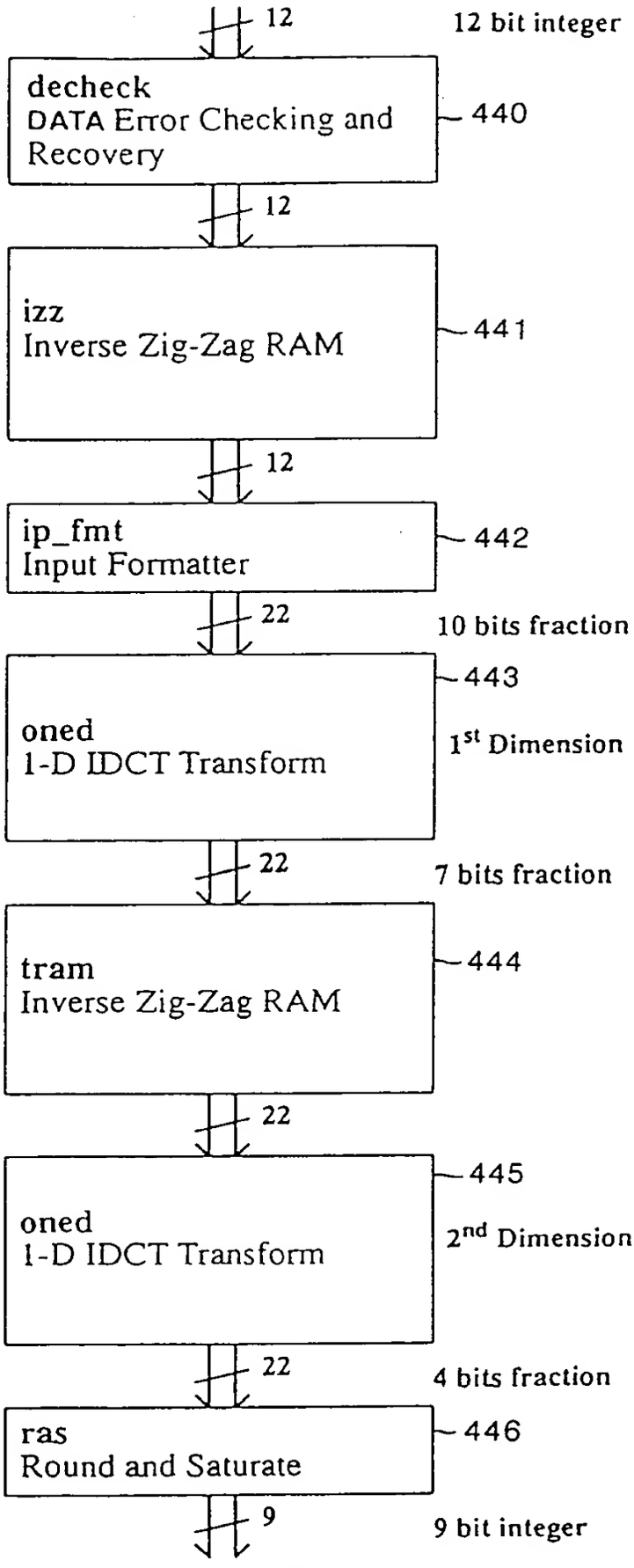

12
12 bit integer
decheck
DATA Error Checking and
Recovery
440
12
izz
Inverse Zig-Zag RAM
441
12
ip_fmt
Input Formatter
442
22
10 bits fraction
oned
1-D IDCT Transform
443
1st Dimension
22
7 bits fraction
tram
Inverse Zig-Zag RAM
444
22
oned
1-D IDCT Transform
445
2nd Dimension
22
4 bits fraction
ras
Round and Saturate
446
9
9 bit integer

FIG. 139

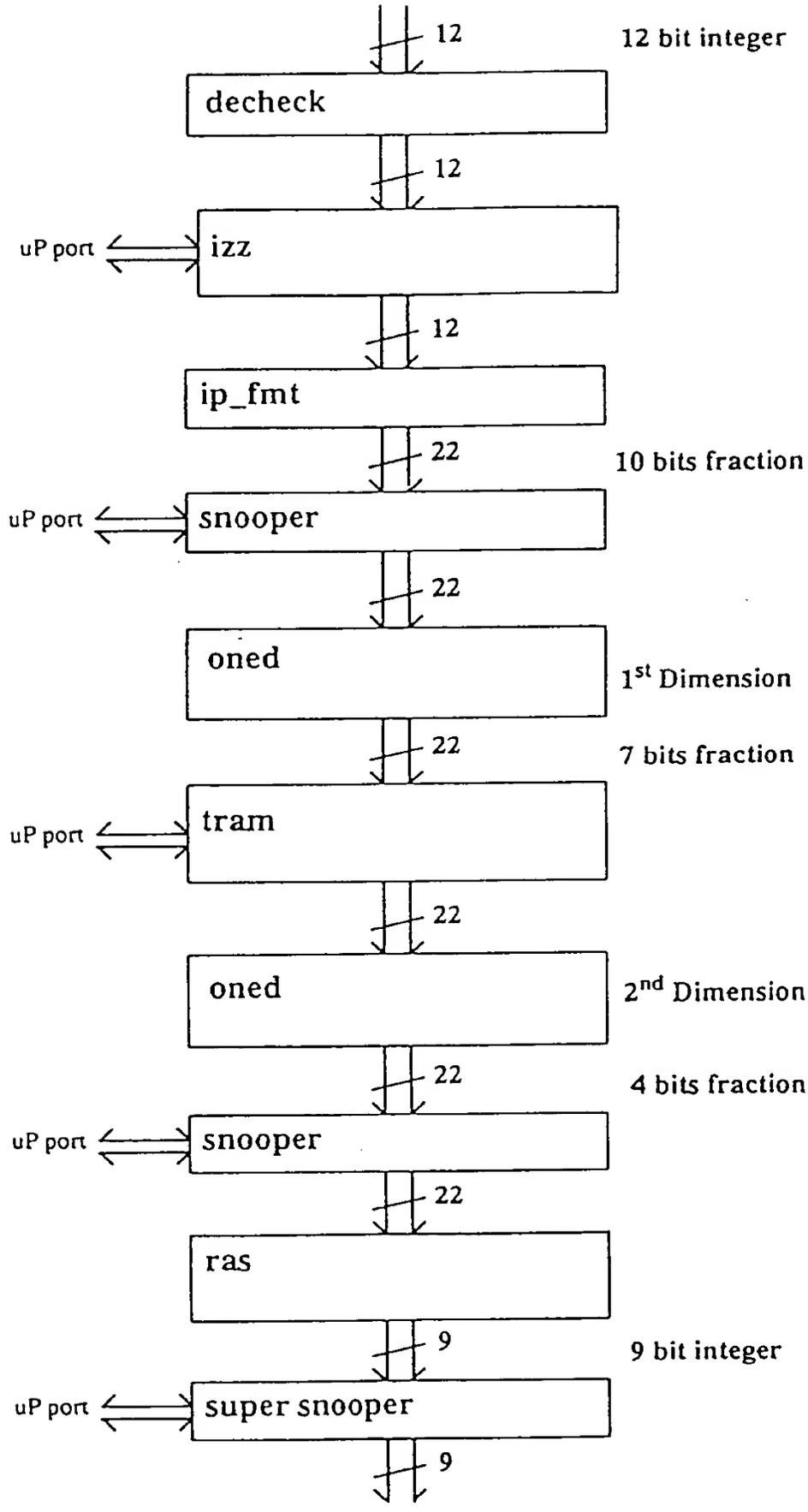
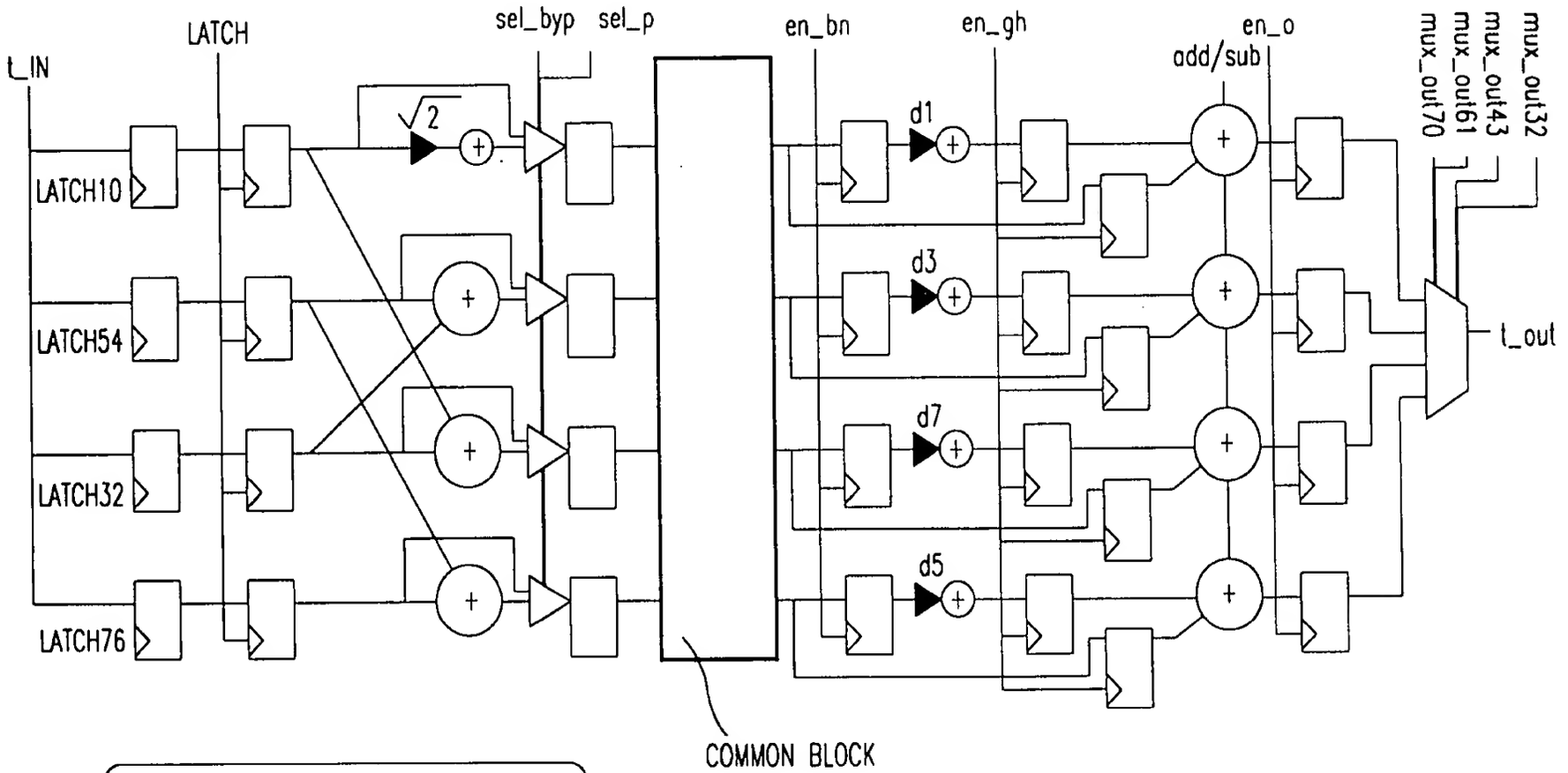
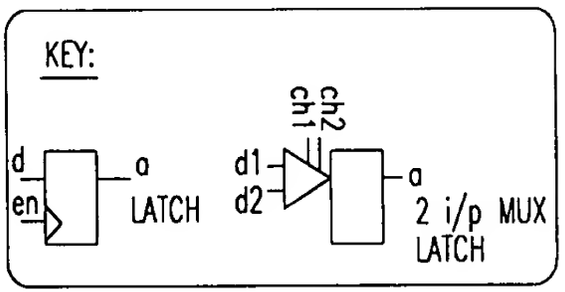

12
12 bit integer
decheck
12
uP port
izz
12
ip_fmt
22
10 bits fraction
uP port
snooper
22
oned
1st Dimension
22
7 bits fraction
uP port
tram
22
oned
2nd Dimension
22
4 bits fraction
uP port
snooper
22
ras
9
9 bit integer
uP port
super snooper
9

FIG. 140





NOTE: "COMMON BLOCK" IS ENTIRELY COMBINATIONAL (NO LATCHING)

FIG. 141

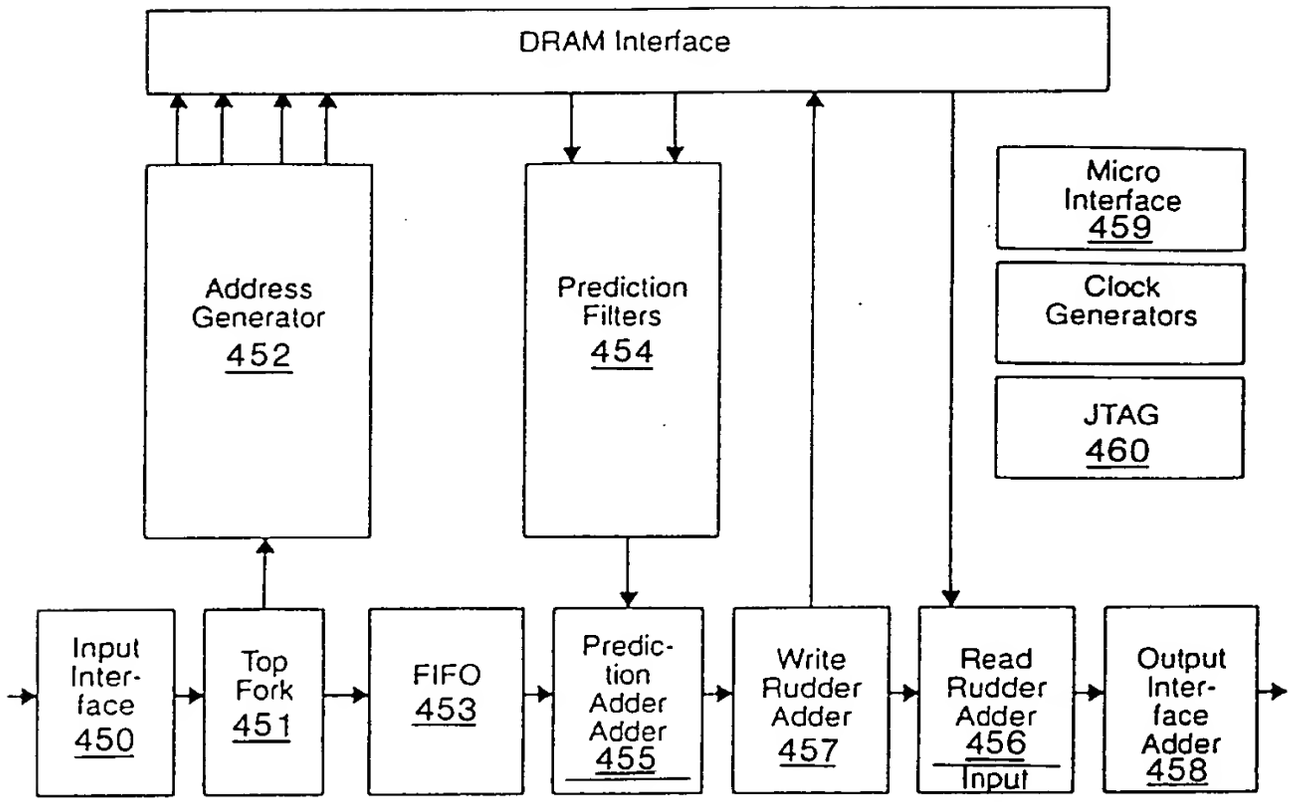

DRAM Interface
Address Generator 452
Prediction Filters 454
Micro Interface 459
Clock Generators
JTAG 460
Input Inter-face 450
Top Fork 451
FIFO 453
Predic-tion Adder Adder 455
Write Rudder Adder 457
Read Rudder Adder 456
Input
Output Inter-face Adder 458

FIG. 142

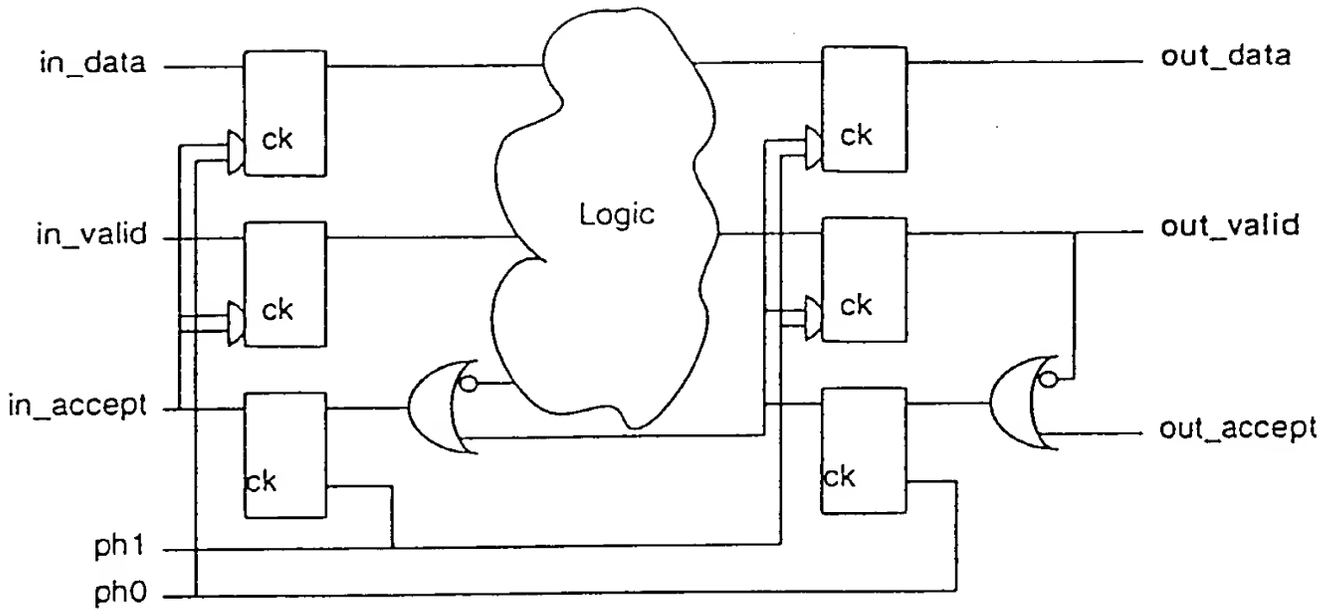

in_data
in_valid
in_accept
ph1
ph0
ck
ck
ck
ck
Logic
ck
ck
ck
out_data
out_valid
out_accept

FIG. 143

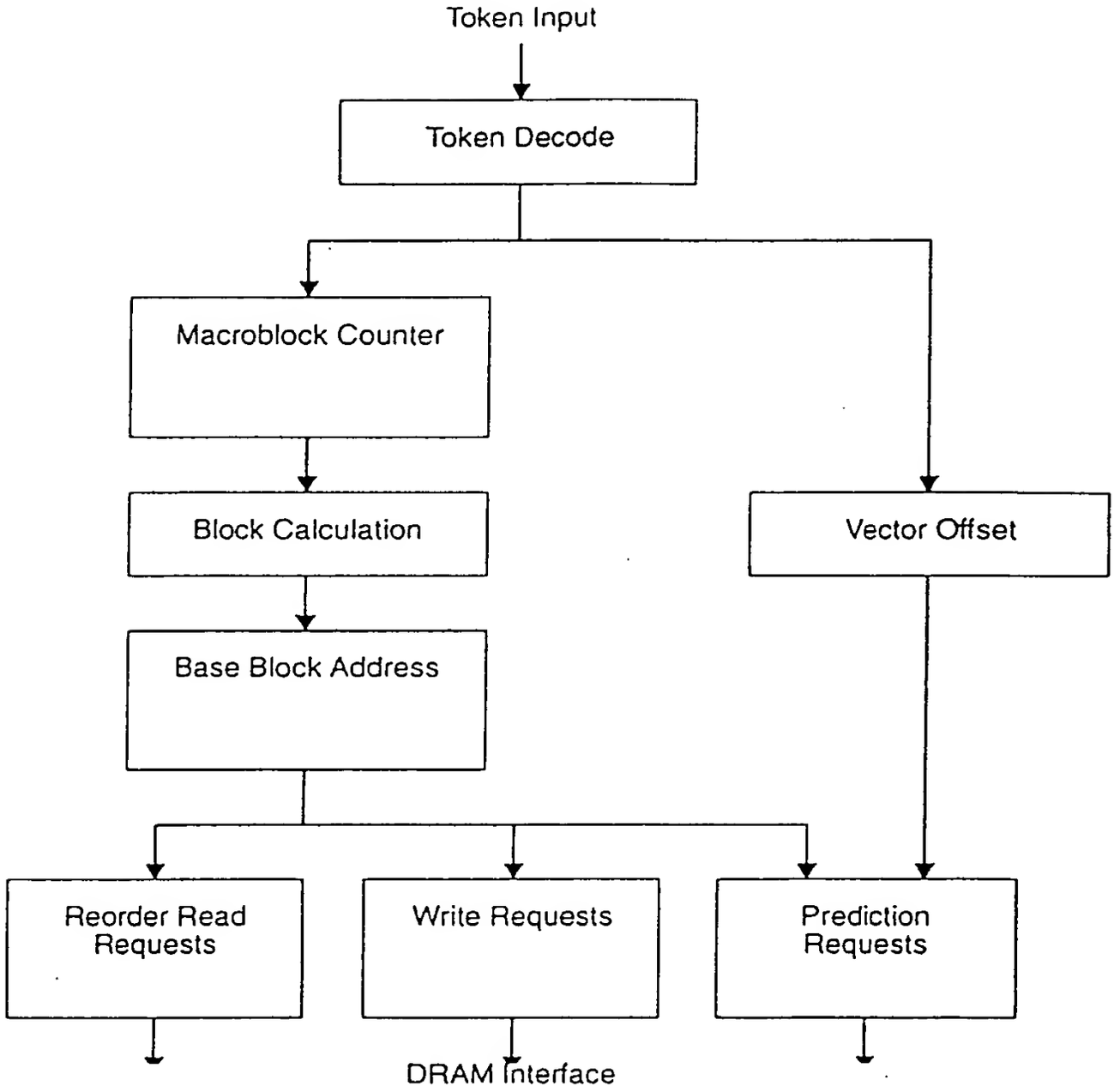

Token Input
Token Decode
Macroblock Counter
Block Calculation
Base Block Address
Vector Offset
Reorder Read Requests
Write Requests
Prediction Requests
DRAM Interface

FIG. 144

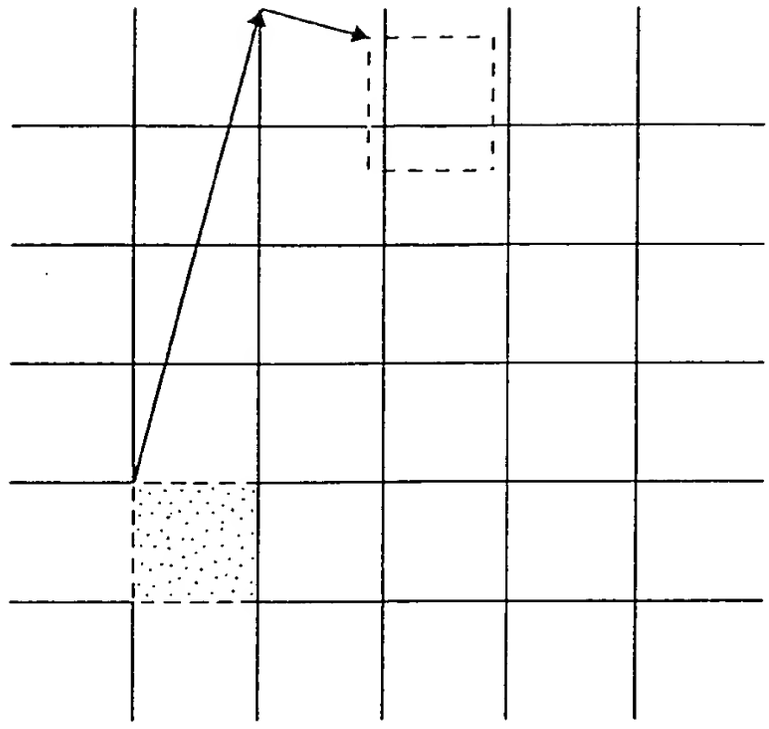


FIG. 145

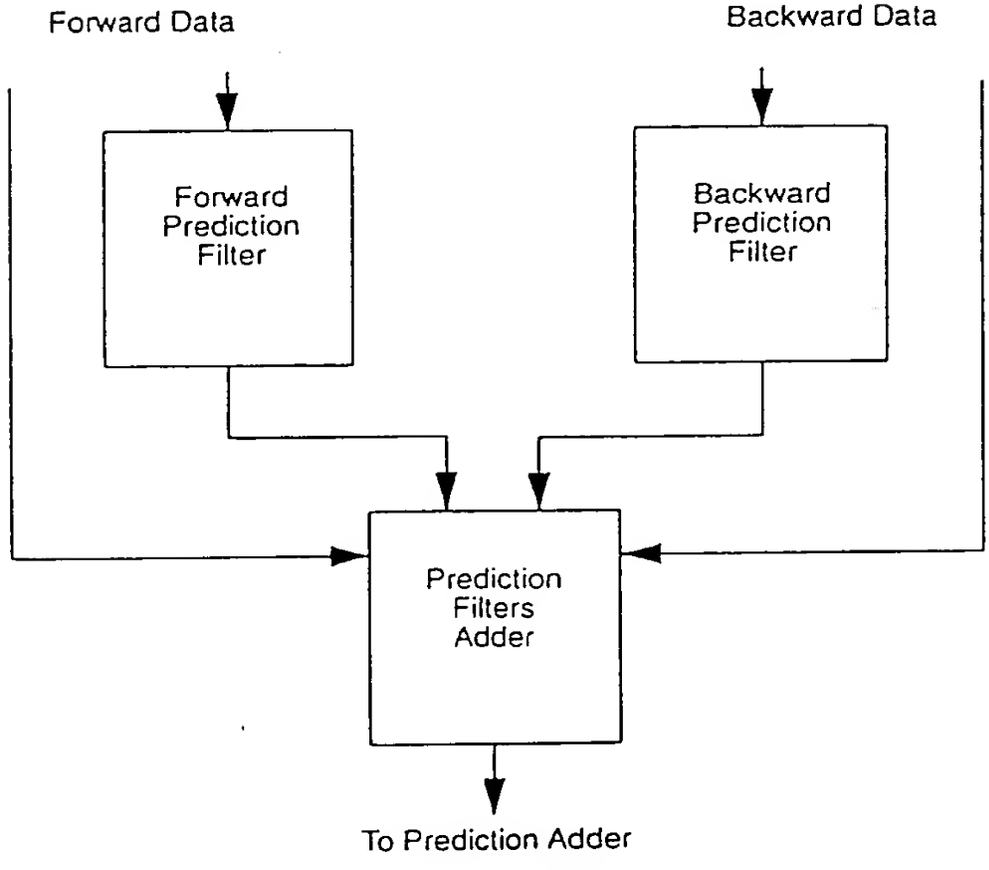


FIG. 146

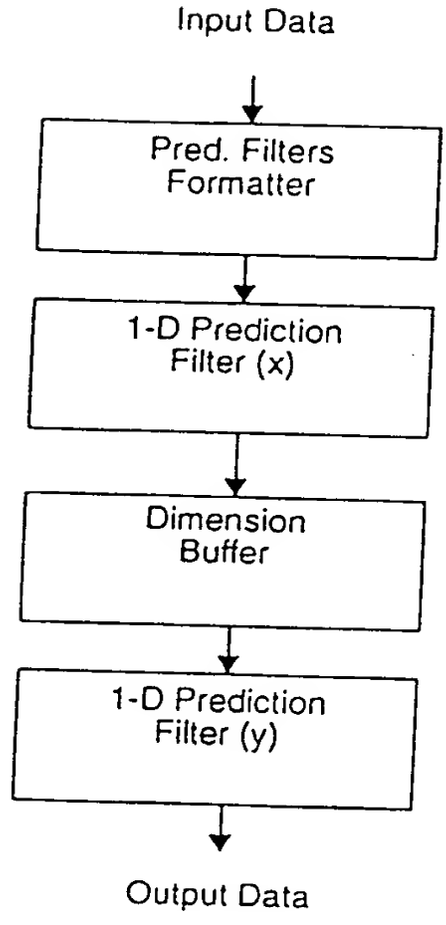

Input Data
Pred. Filters Formatter
1-D Prediction Filter (x)
Dimension Buffer
1-D Prediction Filter (y)
Output Data

FIG. 147

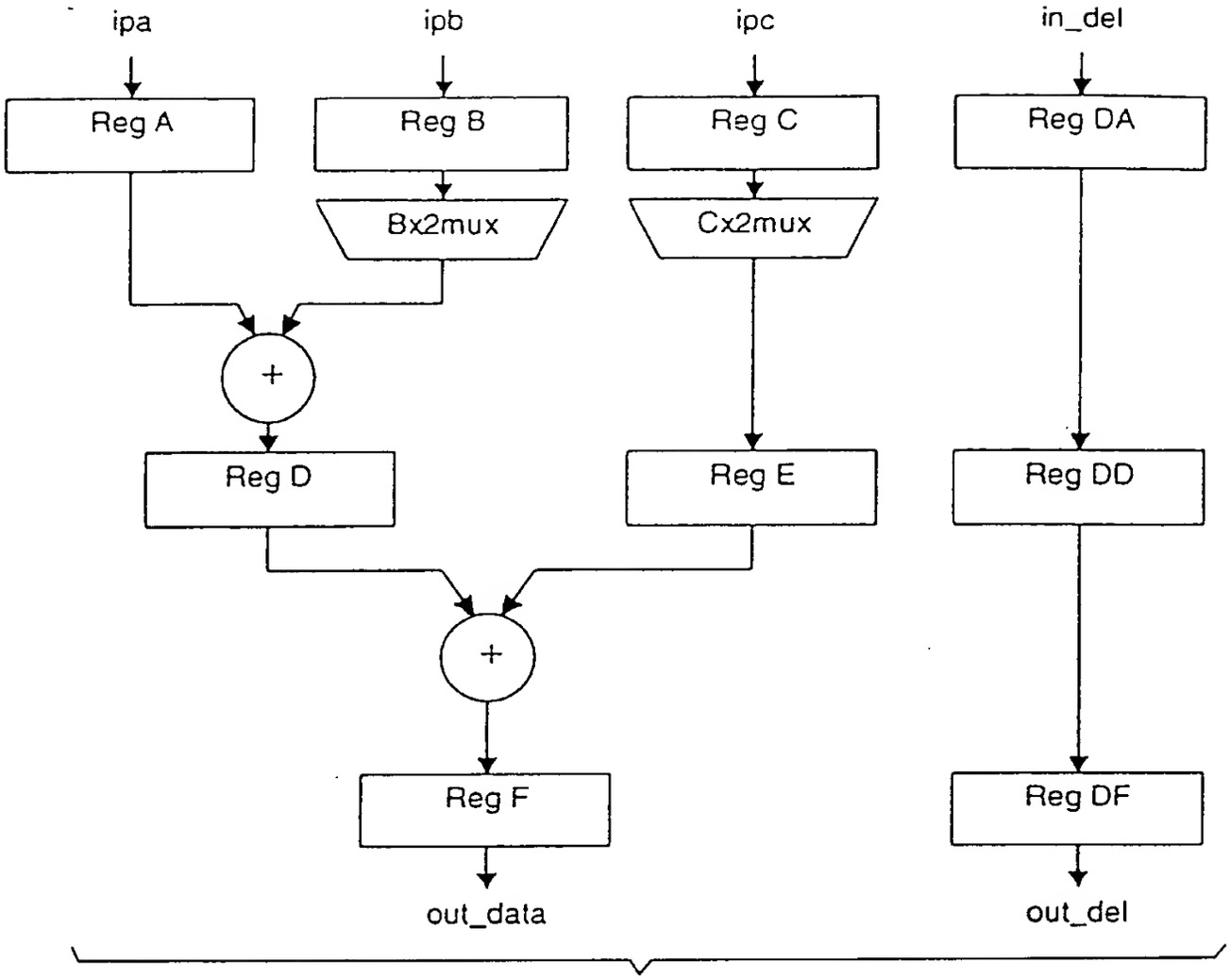


FIG. 148

0	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	31
32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47
48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63

FIG. 149

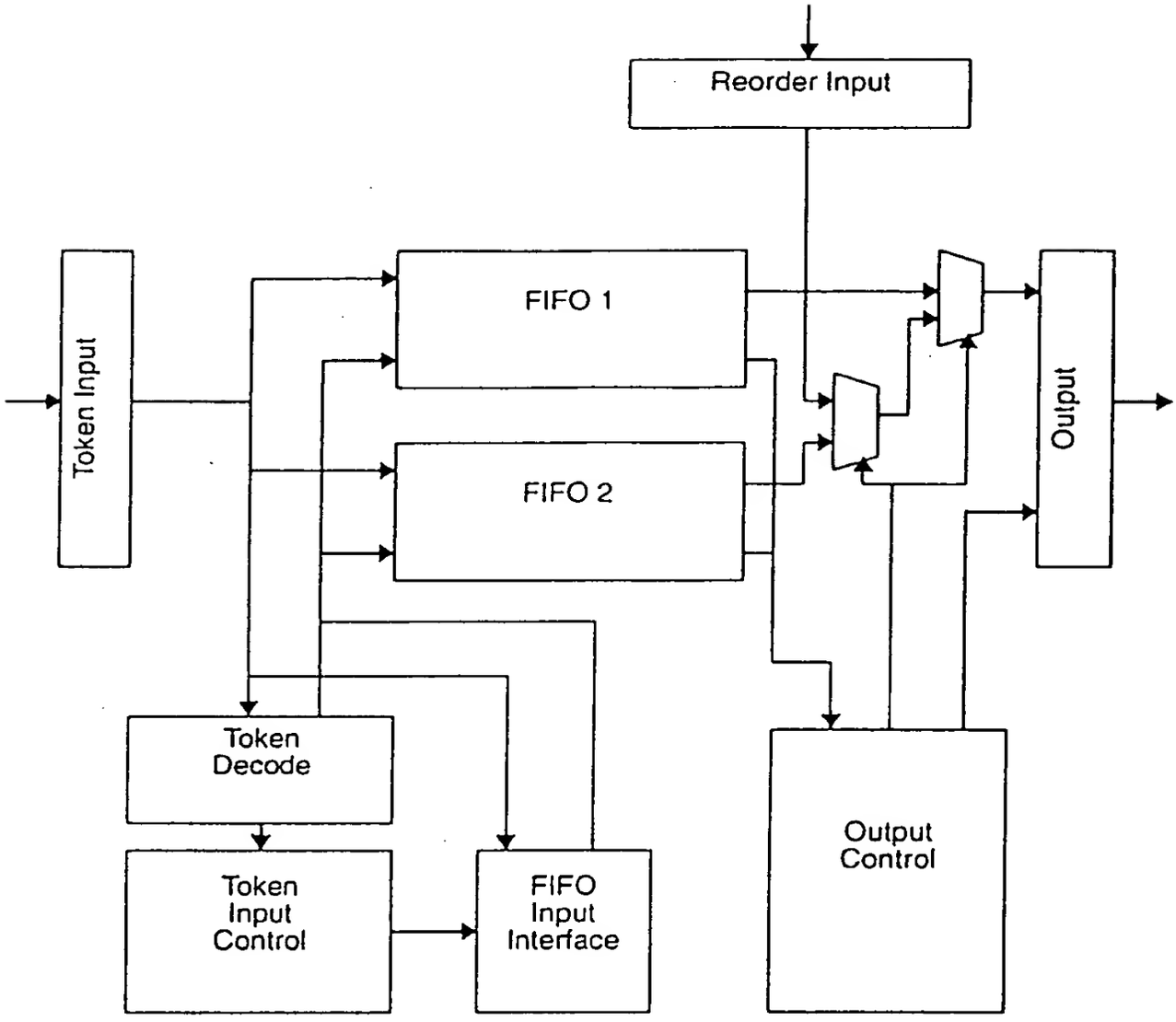

Reorder Input
Token Input
FIFO 1
FIFO 2
Output
Token Decode
Token Input Control
FIFO Input Interface
Output Control

FIG. 150

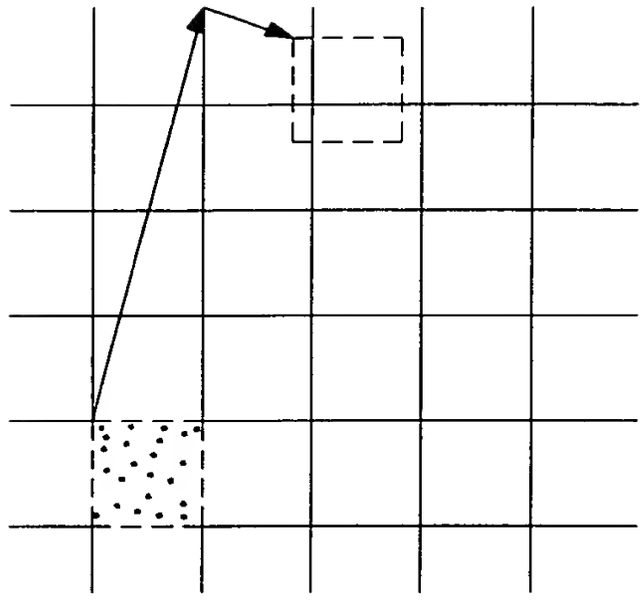


FIG. 151

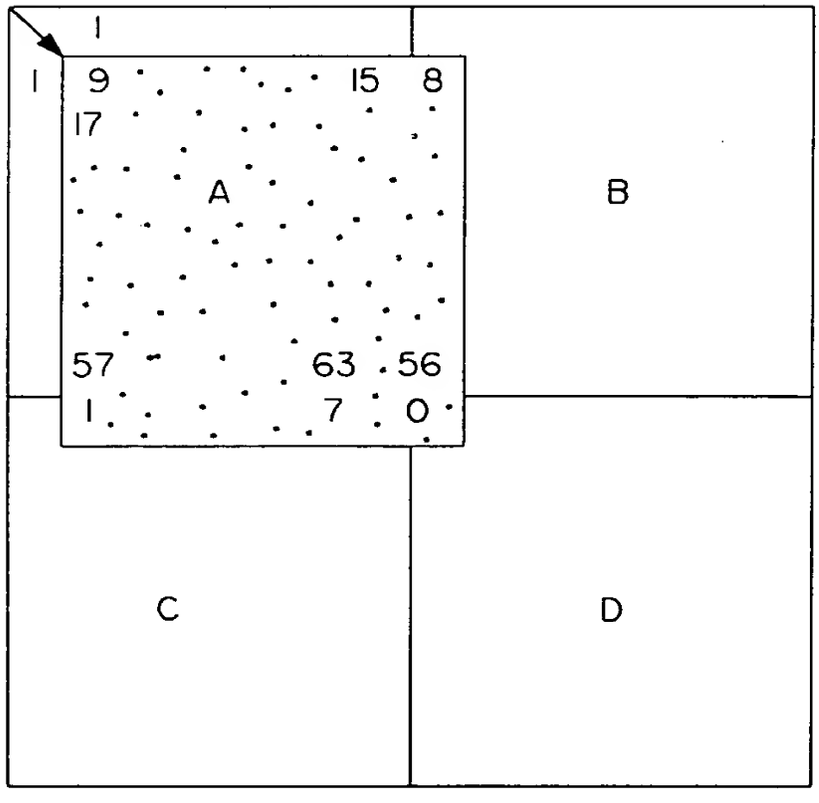


FIG. 152

Read Cycle

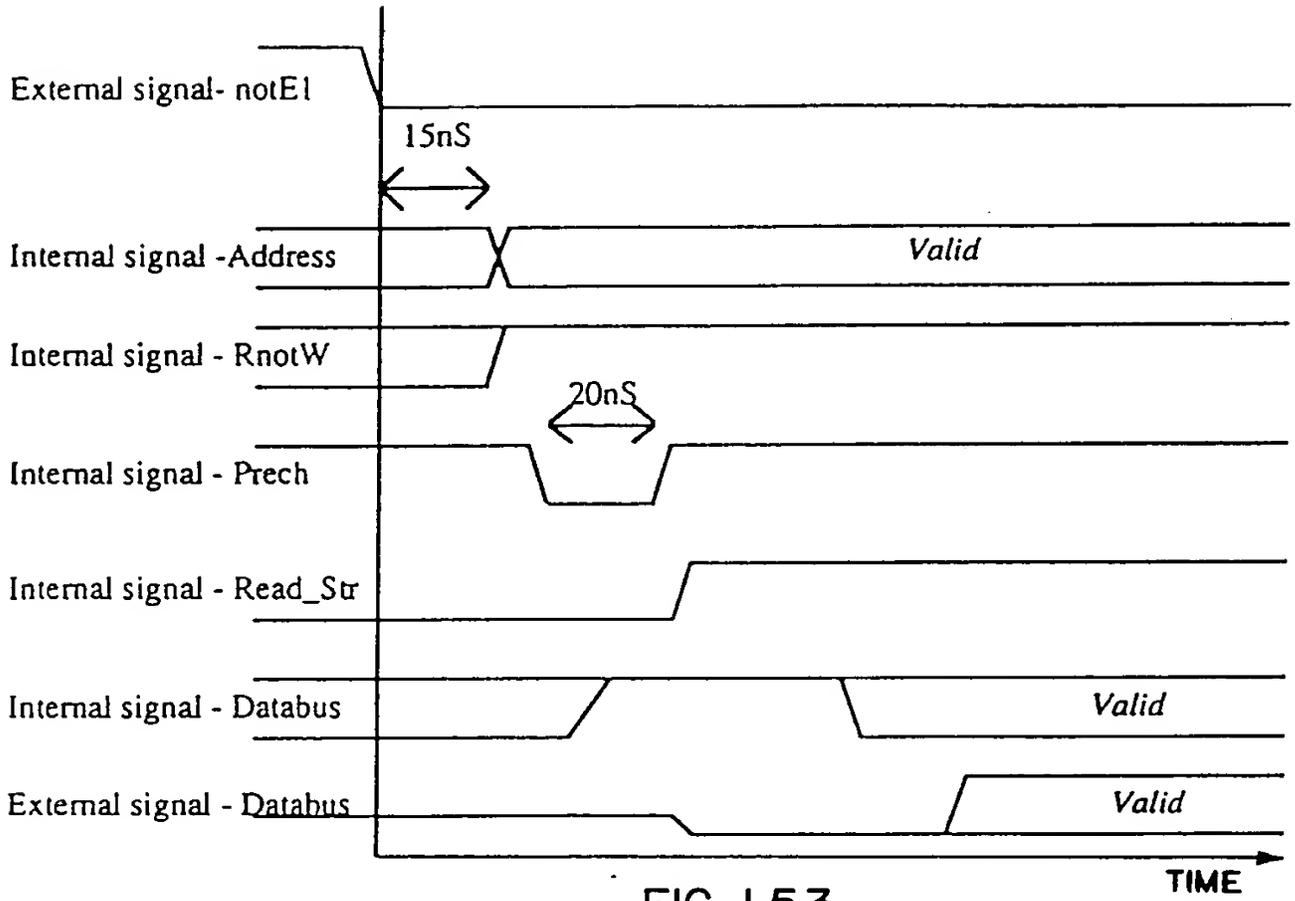


FIG. 153

Write Cycle

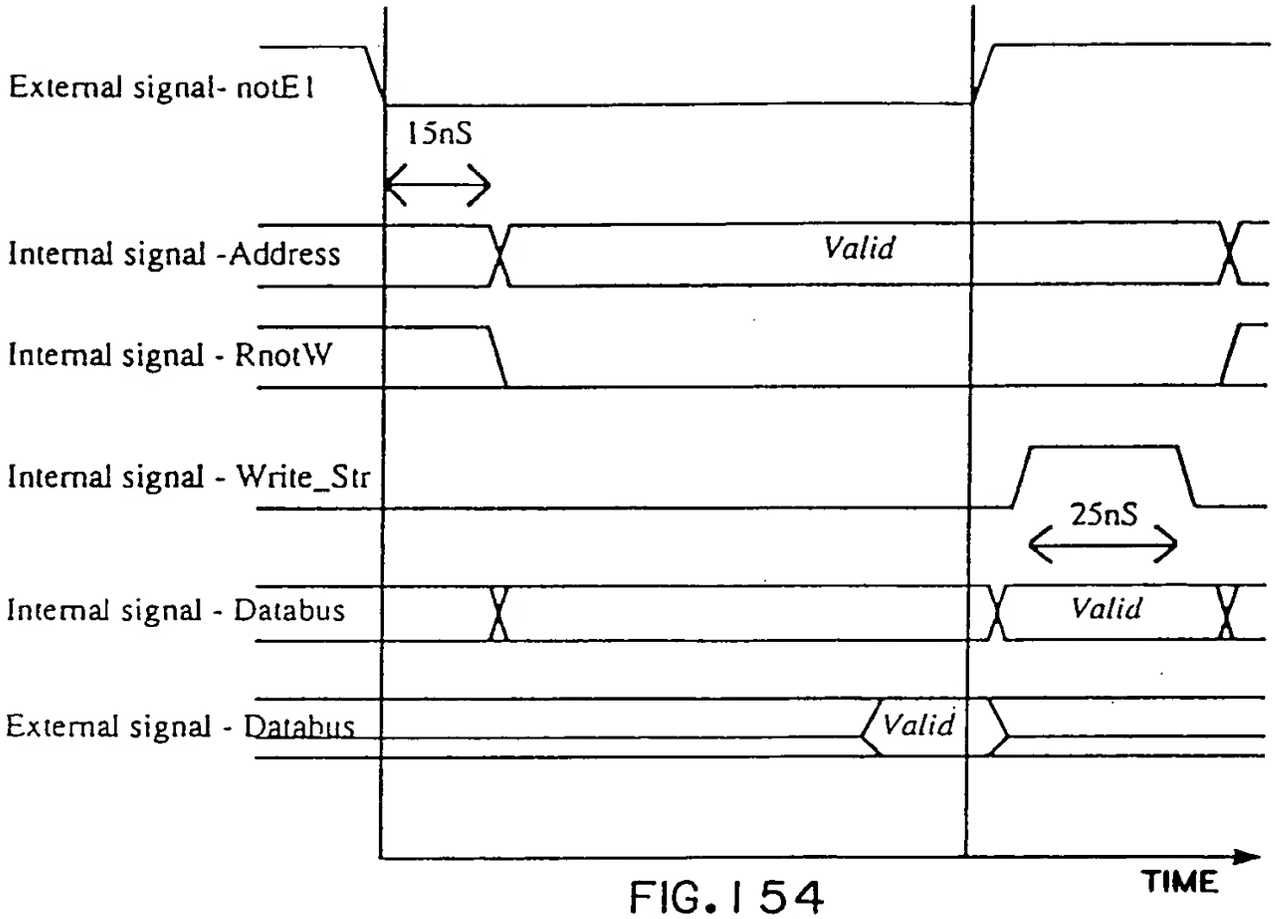


FIG. 154

TOTO20 E24E2760

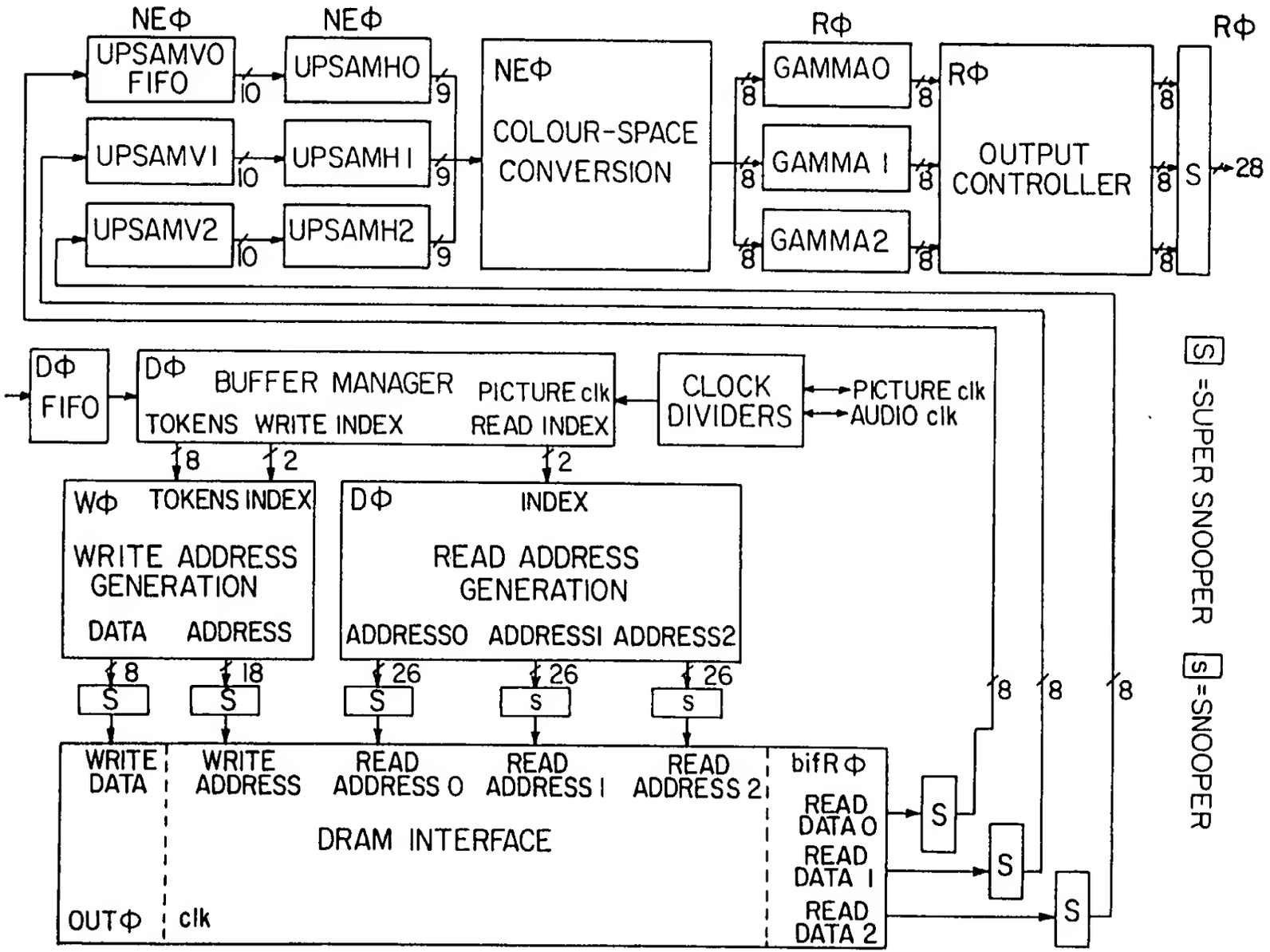


FIG. 155

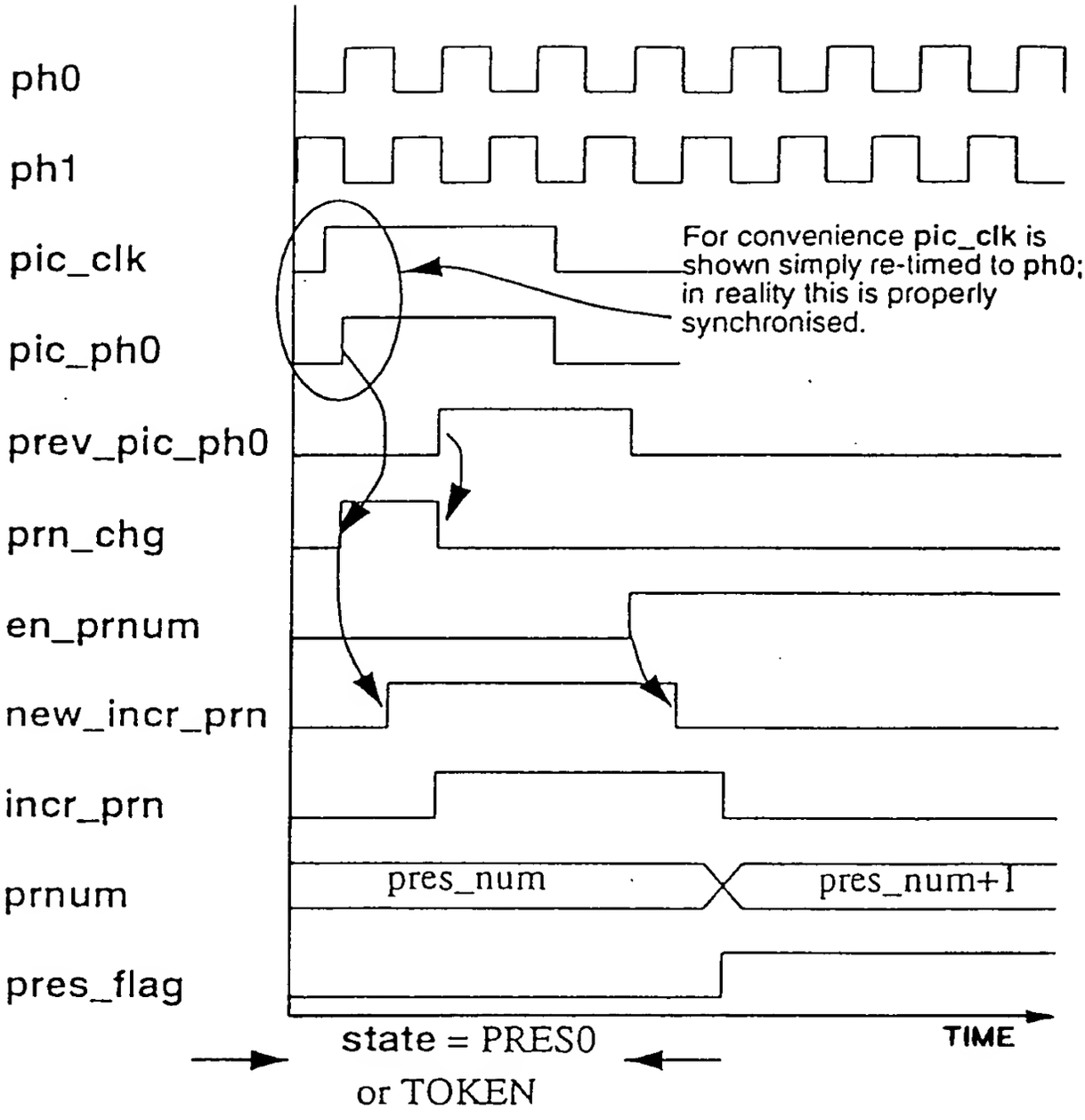

ph0
ph1
pic_clk
pic_ph0
prev_pic_ph0
prn_chg
en_prnum
new_incr_prn
incr_prn
prnum
pres_flag
For convenience pic_clk is shown simply re-timed to ph0; in reality this is properly synchronised.
pres_num
pres_num+1
state = PRES0
or TOKEN
TIME

FIG. 156

5,544,286

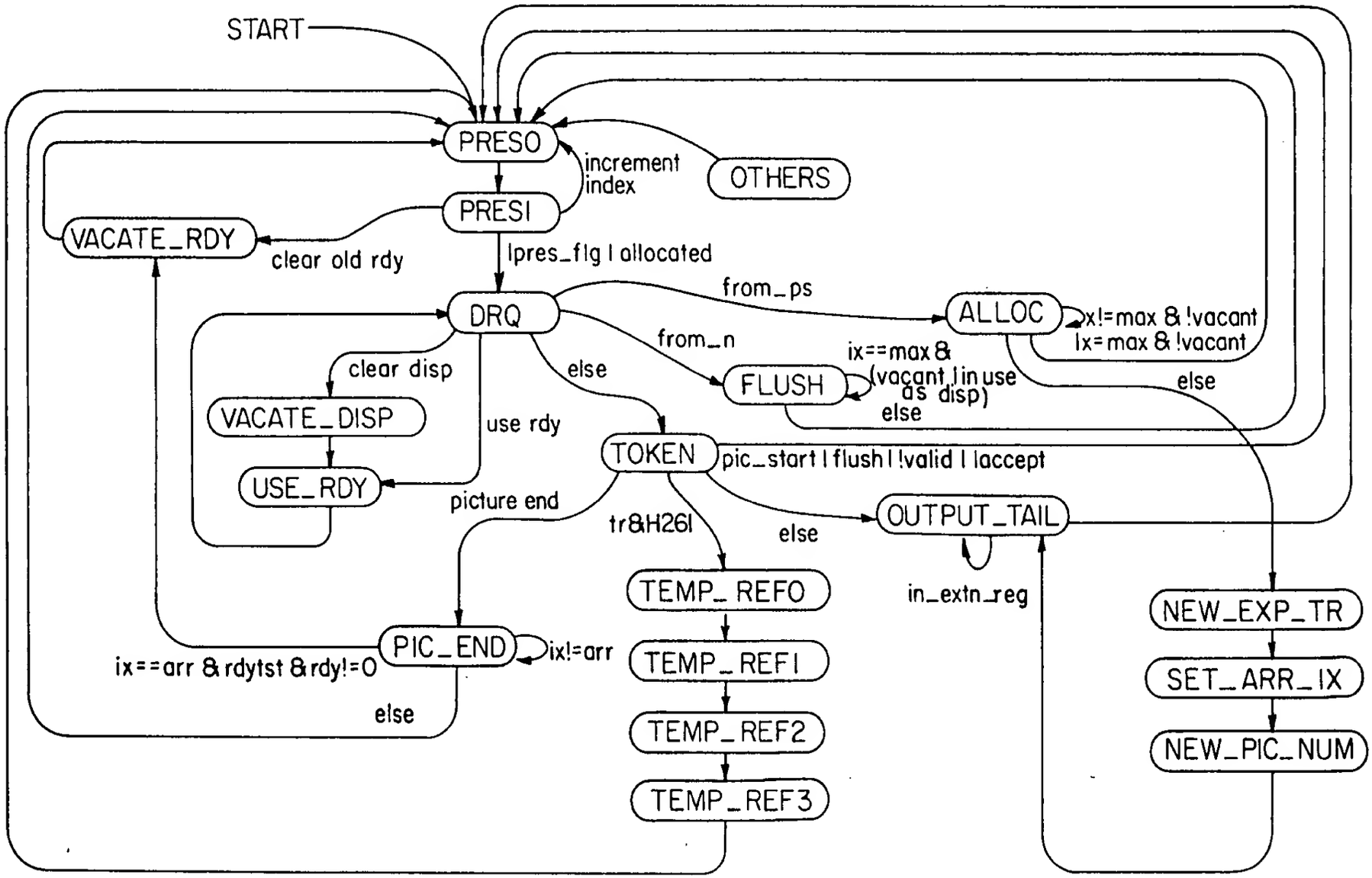


FIG. 157

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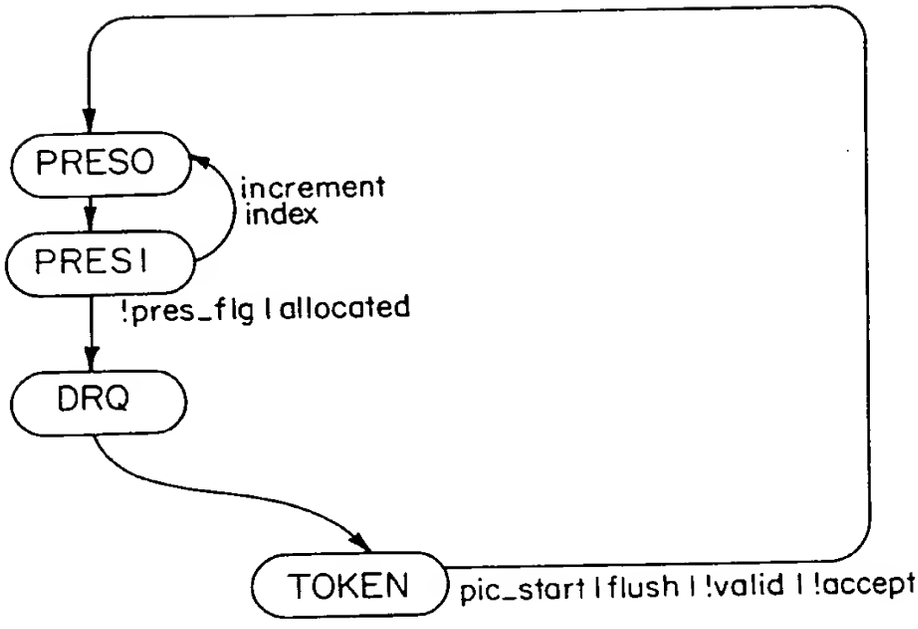


FIG. 158

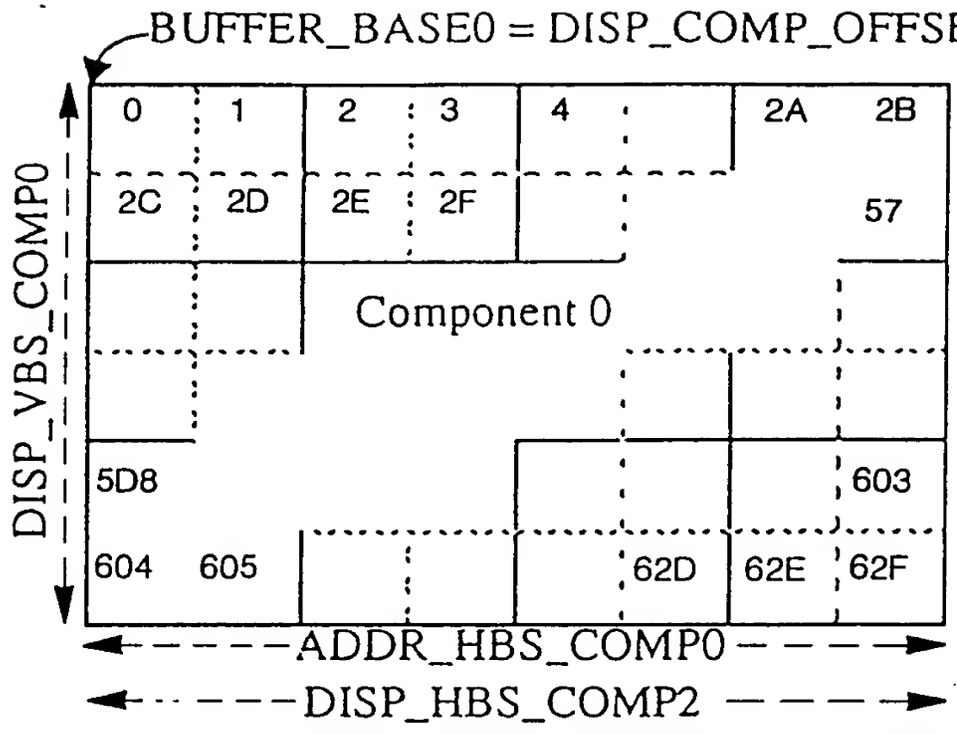


FIG. 159A

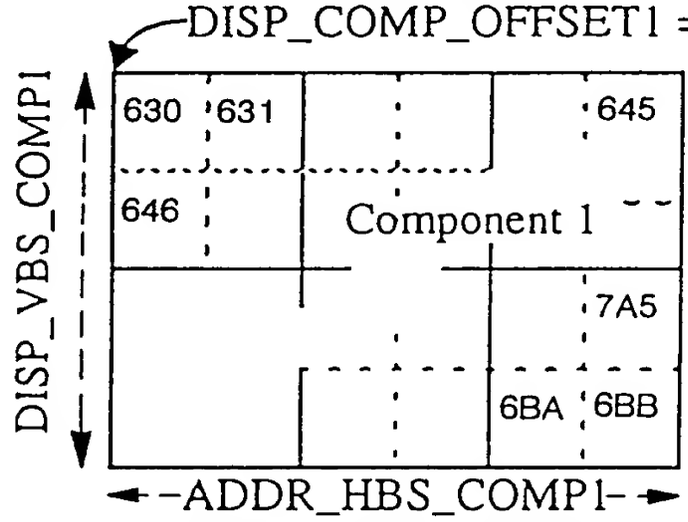


FIG. 159B

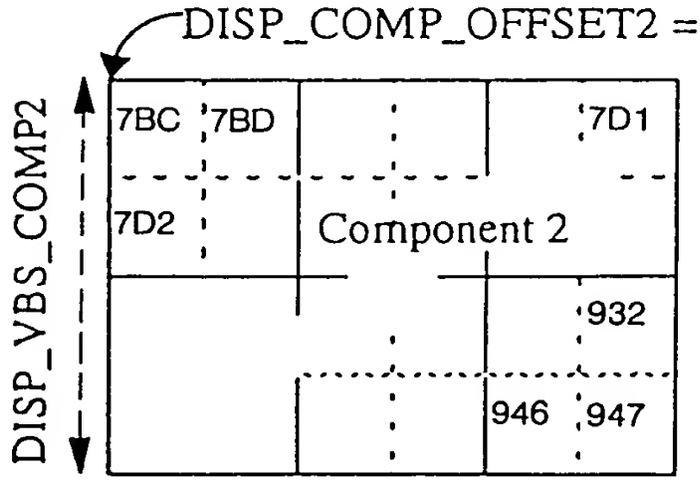


FIG. 159C

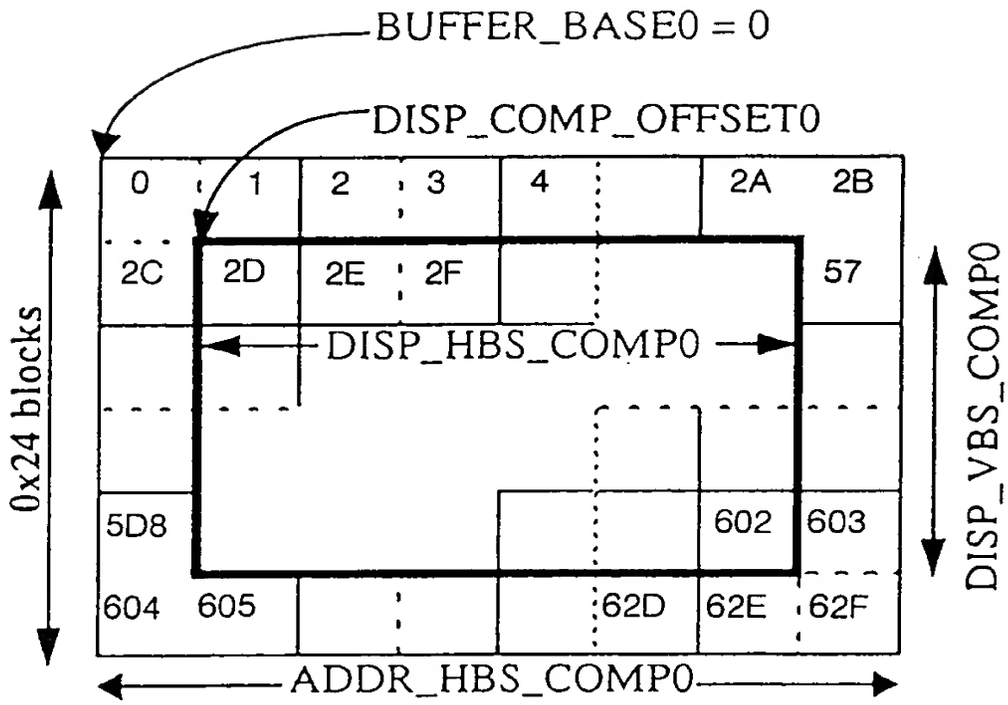

BUFFER_BASE0 = 0
DISP_COMP_OFFSET0
0
1
2
3
4
2A
2B
2C
2D
2E
2F
57
DISP_HBS_COMP0
0x24 blocks
DISP_VBS_COMP0
5D8
602
603
604
605
62D
62E
62F
ADDR_HBS_COMP0

FIG. 160

BUFFER OFFSET 0x00

COMPONENT OFFSET 0x000 + ...

00	01	02	03	04	05	06	07	08	09	0A	0B
0C	0D	0E	0F	10	11	12	13	14	15	16	17
18	19	1A	1B	1C	1D	1E	1F	20	21	22	23
24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
30	31	32	33	34	35	36	37	38	39	3A	3B
3C	3D	3E	3F	40	41	42	43	44	45	46	47
48	49	4A	4B	4C	4D	4E	4F	50	51	52	53
54	55	56	57	58	59	5A	5B	5C	5D	5E	5F
60	61	62	63	64	65	66	67	68	69	6A	6B
6C	6D	6E	6F	70	71	72	73	74	75	76	77
78	79	7A	7B	7C	7D	7E	7F	80	81	82	83
84	85	86	87	88	89	8A	8B	8C	8D	8E	8F

FIG. 161A

COMPONENT1 OFFSET 0x100 + ...

00	01	02	03	04	05
06	07	08	09	0A	0B
0C	0D	0E	0F	10	11
12	13	14	15	16	17
18	19	1A	1B	1C	1D
1E	1F	20	21	22	23

FIG. 161B

COMPONENT1 OFFSET 0x200 + ...

00	01	02	03	04	05
06	07	08	09	0A	0B
0C	0D	0E	0F	10	11
12	13	14	15	16	17
18	19	1A	1B	1C	1D
1E	1F	20	21	22	23

FIG. 161C

5,576,958 - 12/19/96

TOTO20" E2nE2260

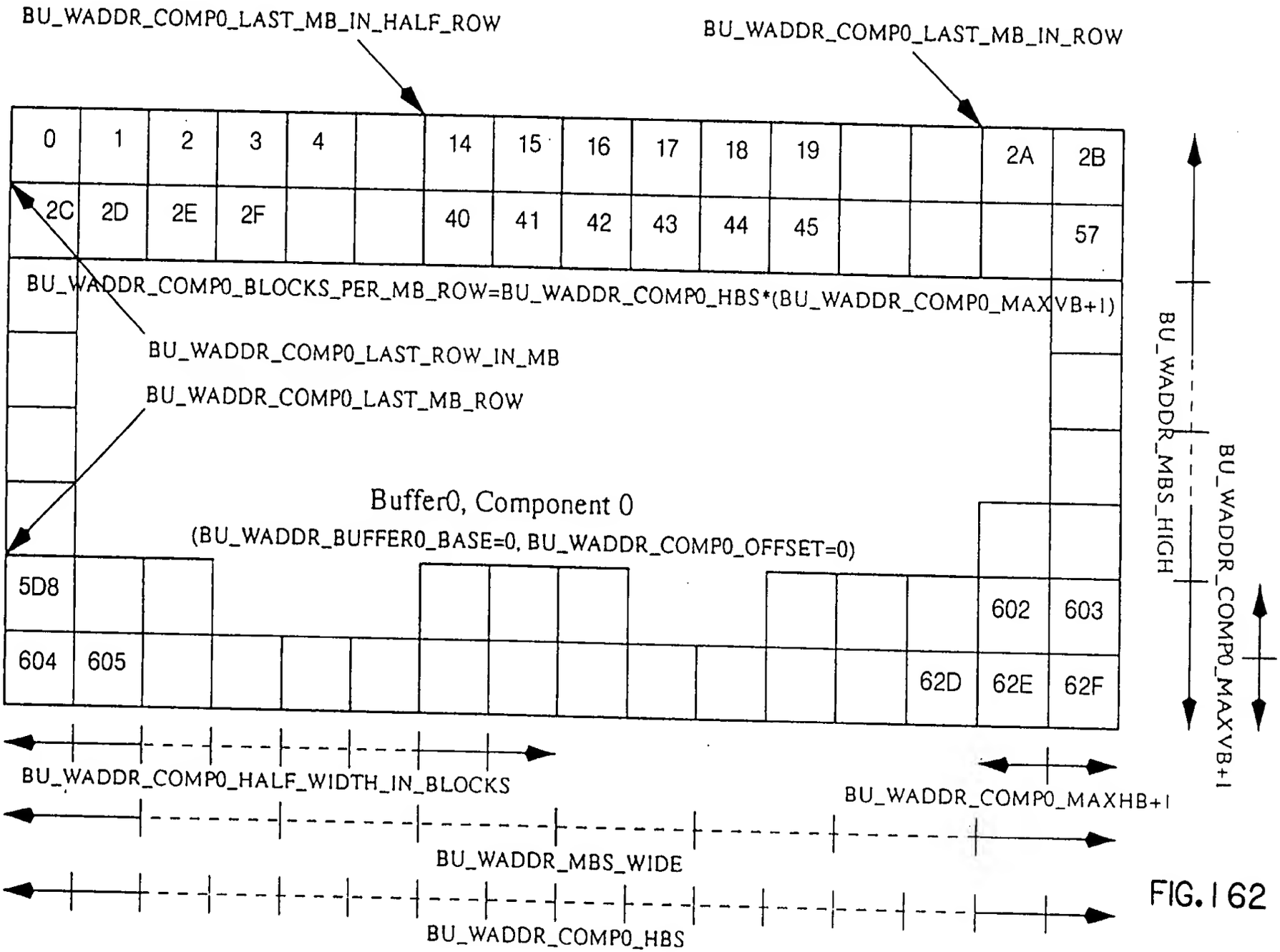
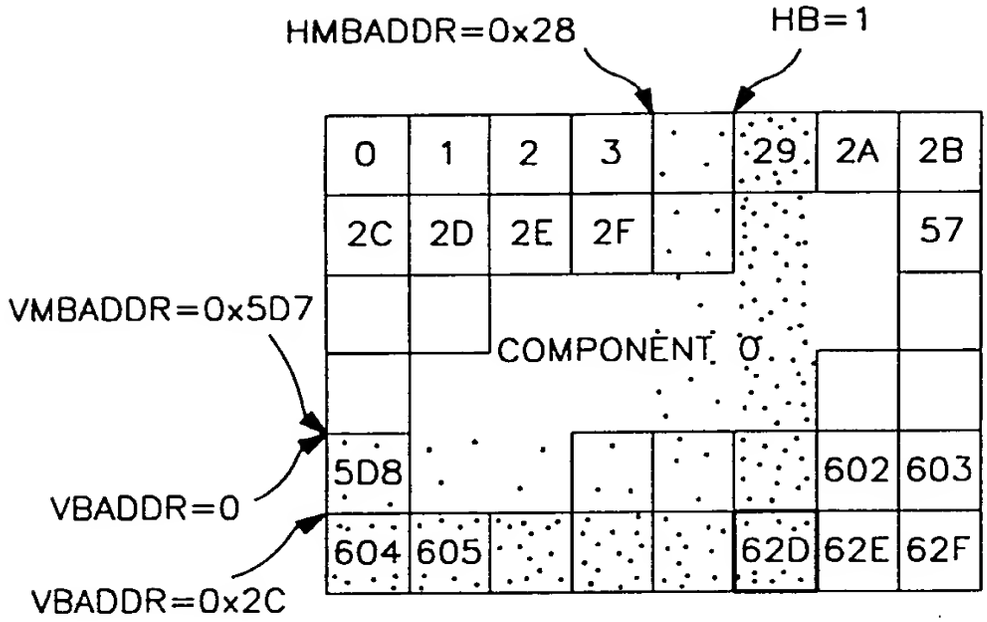
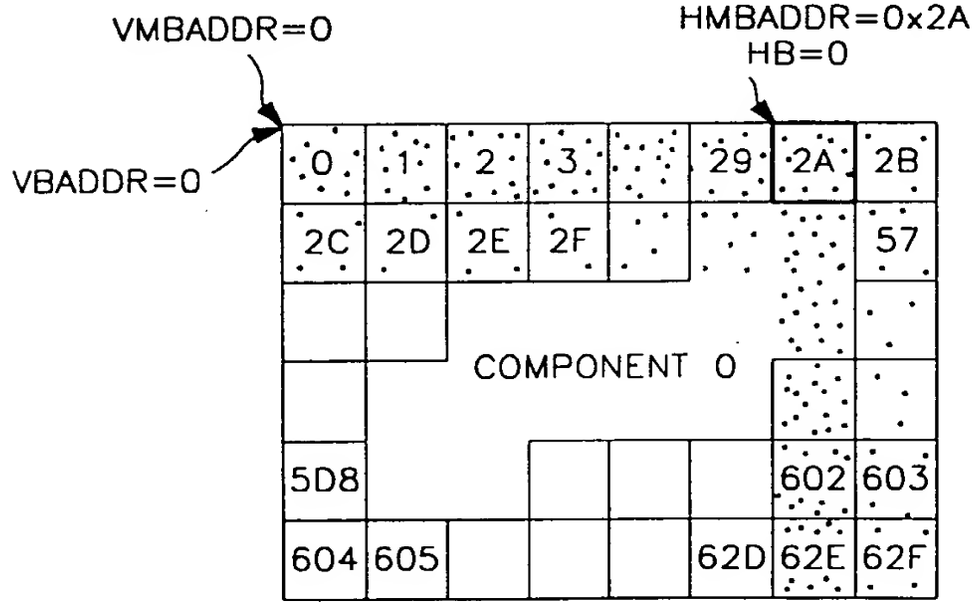


FIG. 162



BLOCK ADDRESS=0+0+0x5D8+0x28+0x2C+1=0x62D

FIG. 163A



BLOCK ADDRESS=0+0+0+0x2A+0+0=0x2A

FIG. 163B

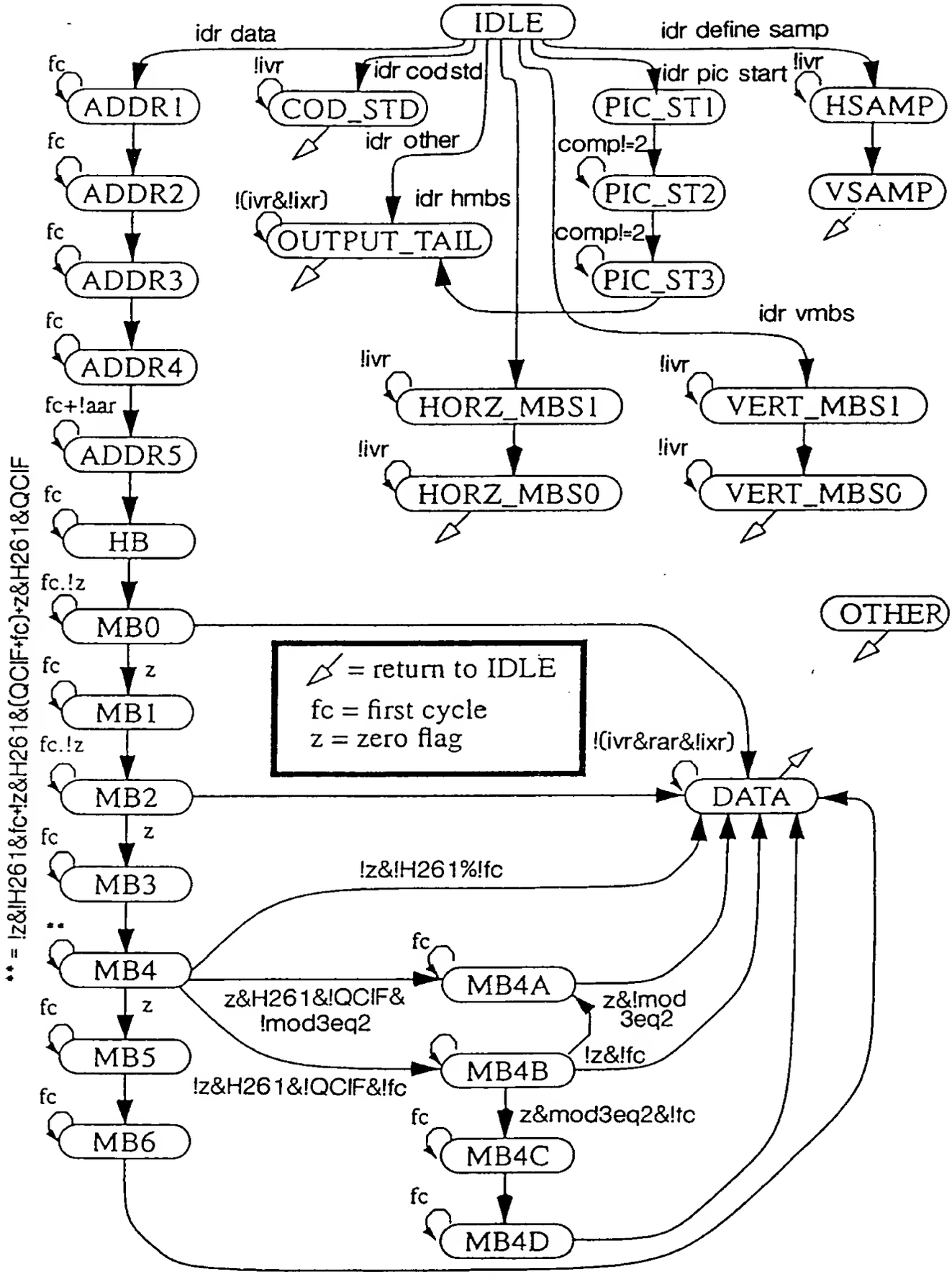

IDLE
idr data
idr cod std
idr other
idr hmbs
idr pic start
idr define samp
idr vmbs
!ivr
fc
ADDR1
ADDR2
ADDR3
ADDR4
ADDR5
HB
MB0
MB1
MB2
MB3
MB4
MB5
MB6
COD_STD
OUTPUT_TAIL
PIC_ST1
PIC_ST2
PIC_ST3
HSAMP
VSAMP
HORZ_MBS1
HORZ_MBS0
VERT_MBS1
VERT_MBS0
OTHER
DATA
MB4A
MB4B
MB4C
MB4D
fc+!aar
fc.!z
z
comp!=2
!(ivr&!ixr)
!(ivr&rar&!ixr)
!z&!H261%!fc
z&H261&!QCIF&
!mod3eq2
z&!mod
3eq2
!z&!fc
!z&H261&!QCIF&!fc
z&mod3eq2&!tc
= return to IDLE
fc = first cycle
z = zero flag
** = !z&!H261&fc+!z&H261&(QCIF+fc)+z&H261&QCIF

FIG. 164

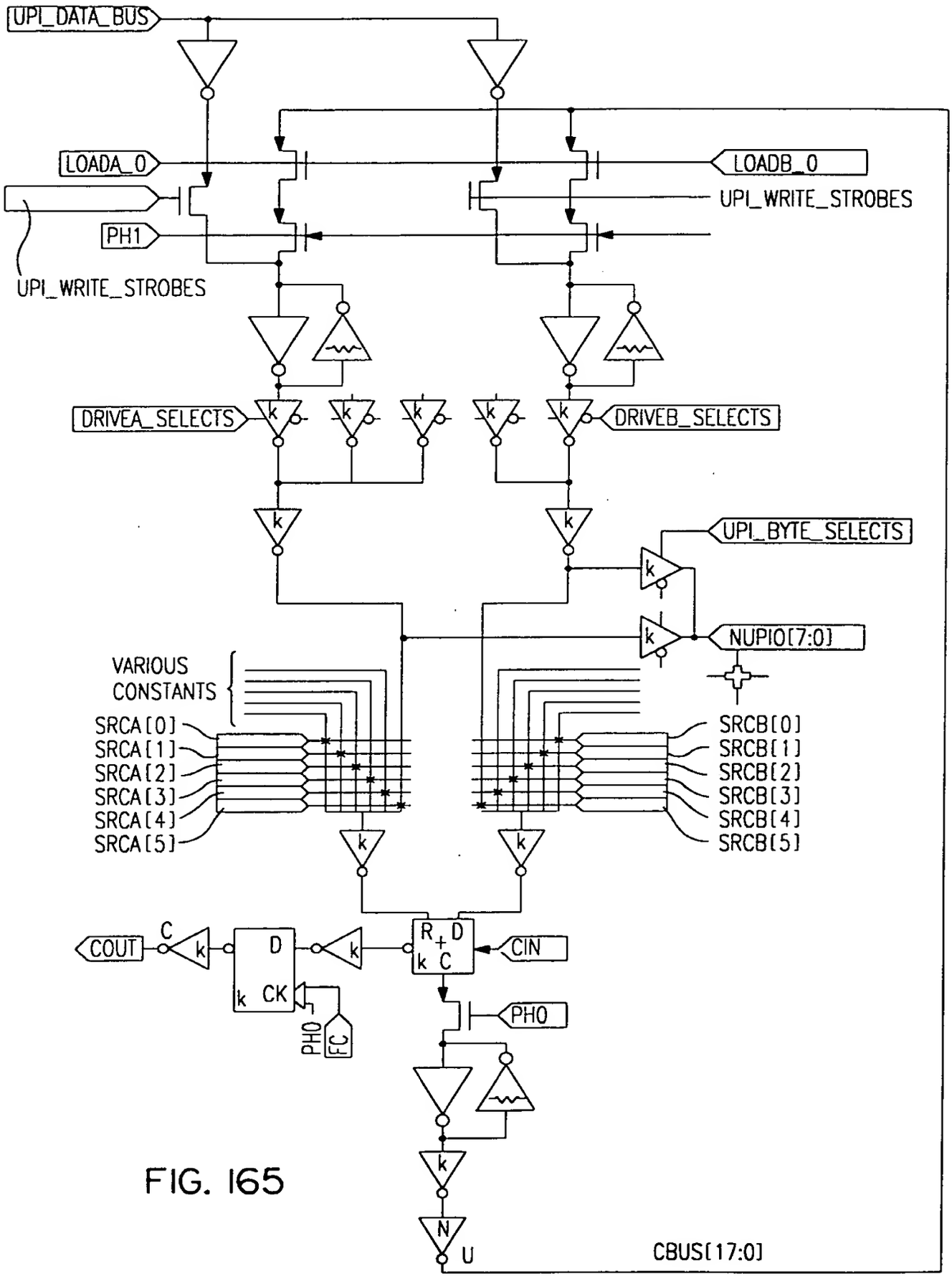

UPI_DATA_BUS
LOADA_0
LOADB_0
UPI_WRITE_STROBES
PH1
UPI_WRITE_STROBES
DRIVEA_SELECTS
DRIVEB_SELECTS
UPI_BYTE_SELECTS
NUPIO[7:0]
VARIOUS
CONSTANTS
SRCA[0]
SRCA[1]
SRCA[2]
SRCA[3]
SRCA[4]
SRCA[5]
SRCB[0]
SRCB[1]
SRCB[2]
SRCB[3]
SRCB[4]
SRCB[5]
COUT
C
D
CK
R
D
C
CIN
PH0
PH0
FC
PH0
N
U
CBUS[17:0]

FIG. 165

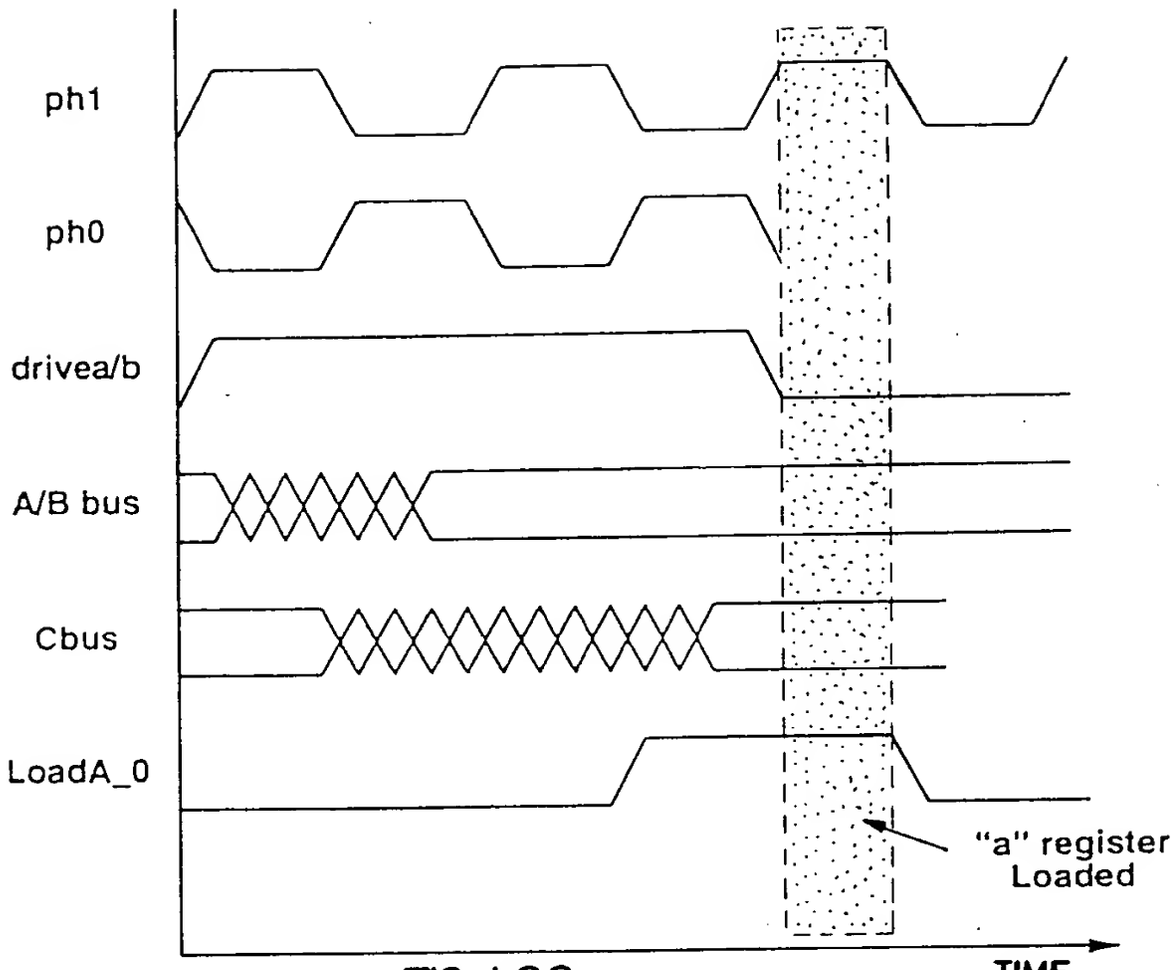


FIG. 166

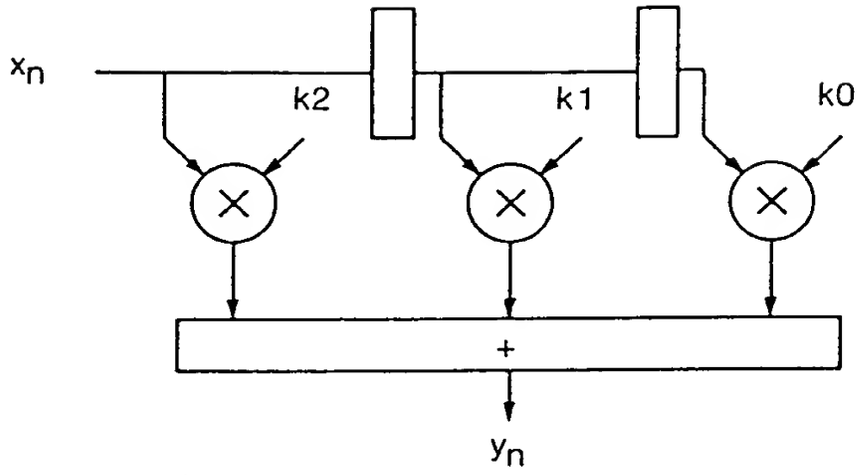


FIG. 167

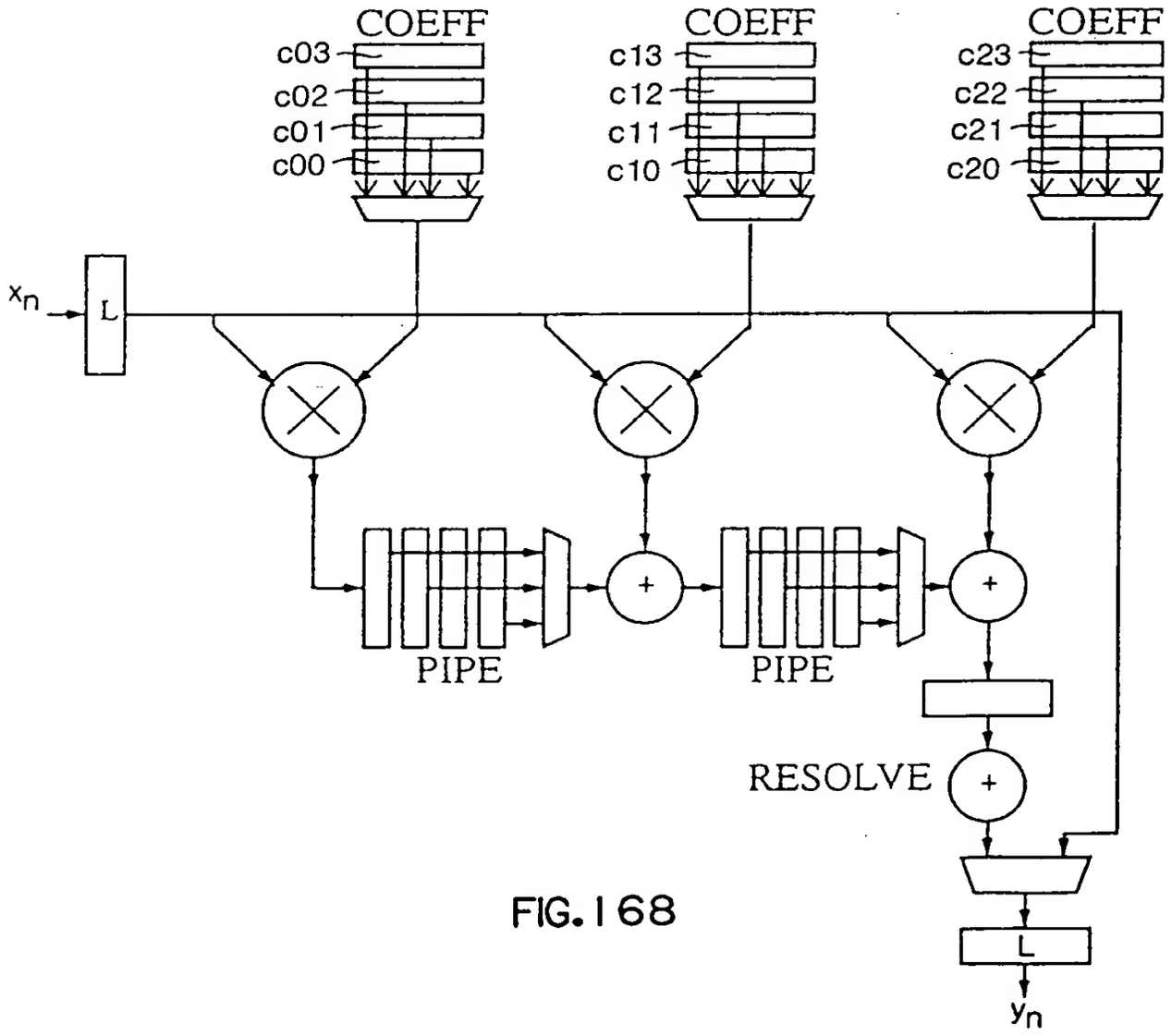


FIG. 168

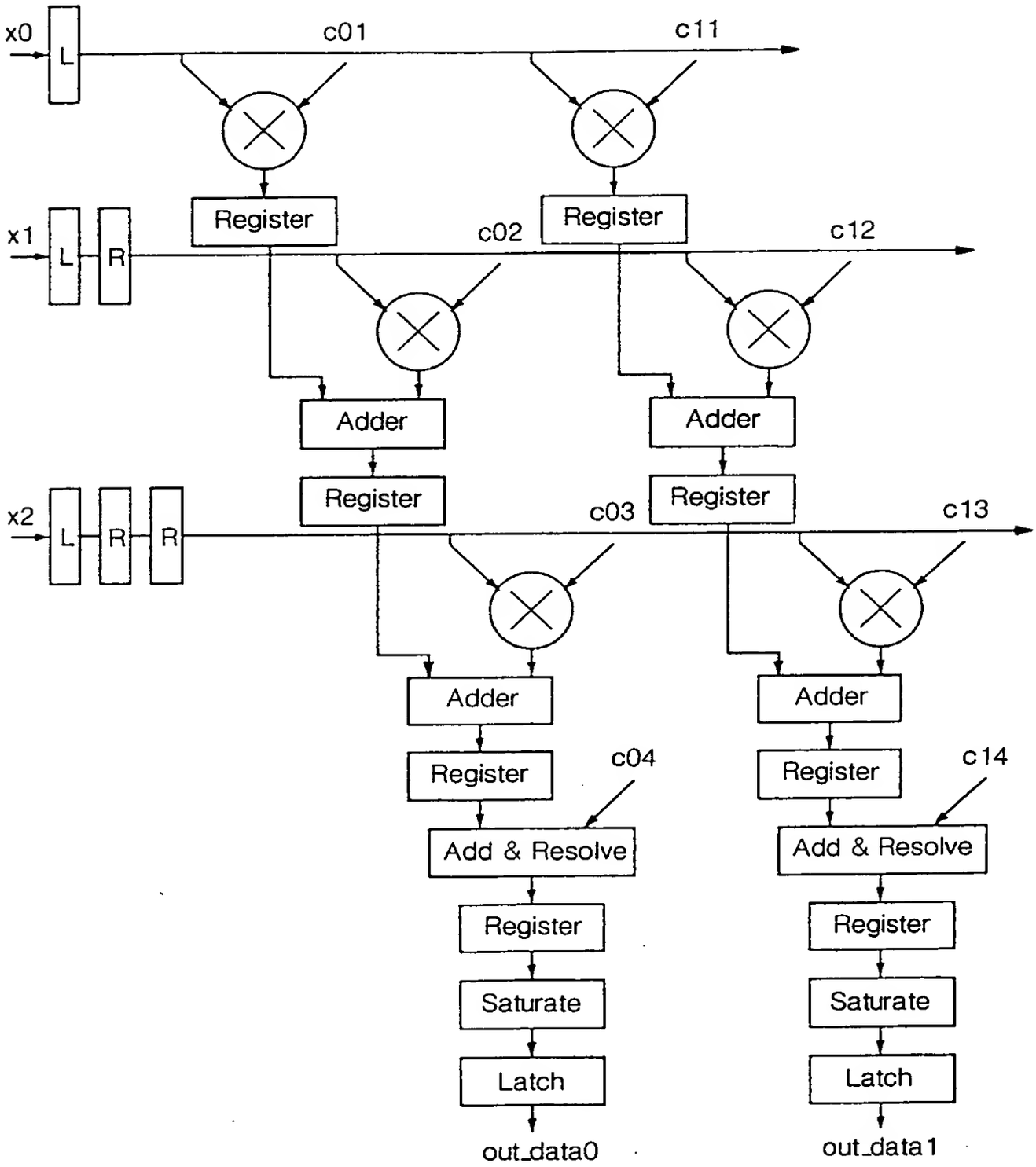

x0
L
c01
c11
Register
Register
x1
L
R
c02
c12
Adder
Adder
Register
Register
x2
L
R
R
c03
c13
Adder
Adder
Register
Register
c04
c14
Add & Resolve
Add & Resolve
Register
Register
Saturate
Saturate
Latch
Latch
out_data0
out_data1

FIG. 169